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Data from the 1982 Lake Winnipeg fish stock assessment program.

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TABLE OF CONTENTS

	Page
INTRODUCTION	1
METHODS	2
Experimental netting	2
Commercial sampling	2
Calculations	3
RESULTS	5
Maturity regimes	5
Growth regimes	5
Mesh size effects	6
Age compositions, catch curves and mortality rates	6
REFERENCES	7
APPENDIX A	98

LIST OF TABLES

Table		Page
1.	1982 experimental gang locations	8
2.	1982 commercial sampling schedule	9
3.	Numbers of unsampled fish from various meshes of experimental gangs set in the three major areas of Lake Winnipeg	10
4.	1982 maturity schedules of Lake Winnipeg walleyes	11
5.	1982 maturity schedules for Lake Winnipeg saugers	12
6.	1981 maturity schedules for Lake Winnipeg whitefish	13
7.	1982 maturity curves of Lake Winnipeg walleyes, saugers and whitefish	14
8.	Age-specific mean fork lengths and mean weights of walleyes from the north basin, channel and south basin of Lake Winnipeg, 1982	15
9.	Age-specific mean fork lengths and mean weights of saugers from the north basin, channel and south basin of Lake Winnipeg, 1982	16
10.	Age-specific mean fork lengths and mean weights of whitefish from the north basin and channel of Lake Winnipeg, 1982	17
11.	Age-specific mean length-weight curves of walleyes, saugers, and whitefish from the three major areas of Lake Winnipeg, 1982	18
12.	Walford curves of walleyes, saugers and whitefish from the three major areas of Lake Winnipeg, 1982	19

Table | Page

13. Relationship of $\log_e (L_\infty - l_t)$ and t (years) for walleyes, saugers and whitefish, 1982 20
14. Exponential and von Bertalanffy growth curves of walleyes, saugers and whitefish from the three major areas of Lake Winnipeg, 1982. 21
15. Covariance analyses of walleye, sauger and whitefish growth curves 22
16. Mesh size effects on south basin walleyes 23
17. Mesh size effects on channel walleyes 24
18. Mesh size effects on north basin walleyes 25
19. Mesh size effects on south basin saugers 26
20. Mesh size effects on channel saugers. 27
21. Mesh size effects on north basin saugers 28
22. Mesh size effects on channel whitefish 29
23. Mesh size effects on north basin whitefish 30
24. Mortality and survival rates of walleyes, saugers and whitefish from the three major areas of Lake Winnipeg, 1982. 31
25. Age compositions, mean lengths, mean weights and mean weighted ages of commercially sampled species from the three major areas of Lake Winnipeg, 1982. 32

LIST OF FIGURES

Figure		Page
1.	Locations of sampling stations on Lake Winnipeg	33
2.	Maturity curves of south basin walleyes	34
3.	Maturity curves of south basin saugers	35
4.	Maturity curves of channel saugers.	36
5.	Maturity curves of north basin saugers	37
6.	Maturity curves of channel whitefish.	38
7.	Maturity curves of north basin whitefish	39
8.	Age-specific mean length-weight curves of walleyes	40
9.	Age-specific mean length-weight curves of saugers	41
10.	Age-specific mean length-weight curves of whitefish	42
11.	Walford plots for northern walleyes	43
12.	Walford plots for channel walleyes	44
13.	Walford plots for southern walleyes	45
14.	Walford plots for northern saugers	46
15.	Walford plots for channel saugers	47
16.	Walford plots for southern saugers	48
17.	Walford plots for north basin whitefish	49
18.	Walford plots for channel whitefish	50
19.	Plots of $(L_\infty - l_t)$ versus age for northern and southern basin walleyes.	51
20.	Plots of $\log_e (L_\infty - l_t)$ versus age for channel walleyes	52
21.	Plot of $\log_e (L_\infty - l_t)$ versus t for Lake Winnipeg saugers	53

Figure Page

22. Plots of $\log_e (L_\infty - l_t)$ versus age for channel and northern basin whitefish populations 54

23. Exponential growth curves of walleyes from the three major areas of Lake Winnipeg, 1982 55

24. Exponential growth curves of Lake Winnipeg saugers 56

25. Exponential growth curves of channel and north basin whitefish. 57

26. Von Bertalanffy growth curves of walleyes from the south basin, channel and north basin of Lake Winnipeg, 1982 . . 58

27. Von Bertalanffy growth curves of saugers from the three major areas of Lake Winnipeg, 1982 59

28. Von Bertalanffy growth curves of whitefish from the channel and north basin of Lake Winnipeg, 1982 60

29. The relationship of mean ages of walleyes and mesh sizes in the three major areas of Lake Winnipeg, 1982 61

30. Changes in frequencies of immature walleyes in relation to mesh size in the three major areas of Lake Winnipeg, 1982 62

31. Effects of mesh size on the mean numbers of walleyes caught per net in the three major areas of Lake Winnipeg, 1982 63

32. Effects of mesh size on mean weights of saugers caught in the three major areas of Lake Winnipeg, 1982 64

Figure Page

33. Effects of mesh size on the mean biomass per net of walleyes caught in the three major areas of Lake Winnipeg, 1982 65

34. Effects of mesh size on age frequency distributions of north basin walleyes, 1982 66

35. Effects of mesh size on age frequency distributions of channel walleyes, 1982 67

36. Effects of mesh size on age frequency distributions of south basin walleyes, 1982 68

37. The relationship of mean ages of saugers and mesh sizes in the three major areas of Lake Winnipeg, 1982 . . . 69

38. Changes in frequencies of immature saugers in relation to mesh size in the three major areas of Lake Winnipeg, 1982 70

39. Effects of mesh size on the mean numbers of saugers caught per net in the three major areas of Lake Winnipeg, 1982 71

40. Effects of mesh size on mean weights of saugers caught in the three major areas of Lake Winnipeg, 1982 . . . 72

41. Effects of mesh size on the mean biomass per net of saugers caught in the three major areas of Lake Winnipeg, 1982 73

42. Effects of mesh size on age frequency distributions of south basin saugers, 1982 74

Figure Page

43. Effects of mesh size on age frequency distributions of channel saugers, 1982 75

44. Effects of mesh size on age frequency distributions of north basin saugers, 1982 76

45. The relationship of mean ages of whitefish and mesh sizes in the north basin and channel area of Lake Winnipeg, 1982 77

46. Changes in frequencies of immature whitefish in relation to mesh size in the channel area and north basin of Lake Winnipeg, 1982 78

47. Effects of mesh size on the mean numbers of whitefish caught per net in the channel area and north basin of Lake Winnipeg, 1982 79

48. Effects of mesh size on mean weights of whitefish caught in the channel area and north basin of Lake Winnipeg, 1982. 80

49. Effects of mesh size on the mean biomass per net of whitefish caught in the channel and north basin of Lake Winnipeg, 1982 81

50. Effects of mesh size on age frequency distributions of channel whitefish, 1982 82

51. Effects of mesh size on age frequency distributions of north basin whitefish, 1982 83

Figure Page

52. Experimental age compositions of walleyes from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg 84

53. Age compositions of commercially caught walleyes from the south basin of Lake Winnipeg. A - summer, B - fall. . . . 85

54. Age compositions of commercially caught walleyes from the channel area of Lake Winnipeg. A - summer, B - fall . . . 86

55. Age compositions of commercially caught walleyes from the north basin of Lake Winnipeg. A - summer, B - fall . . . 87

56. Experimental age compositions of saugers from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg 88

57. Age compositions of commercially caught saugers from the south basin of Lake Winnipeg in summer (A) and fall(B) . . 89

58. Age compositions of commercially caught saugers from the channel area of Lake Winnipeg in summer (A) and fall (B) . 90

59. Experimental age compositions of whitefish from the north basin (A) and channel (B) area of Lake Winnipeg. 91

60. Age compositions of commercially caught whitefish. A - north basin, summer; B - channel, summer 92

61. Catch curves of experimentally caught walleyes from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg 93

Figure Page

62. Catch curves of commercially caught walleyes from the north basin (A, D), channel area (B, E) and south basin (C, F) in summer (A-C) and fall (D-F) 94

63. Catch curves of experimentally caught saugers from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg. 95

64. Catch curves of commercially caught saugers from the channel area (A, C) and south basin (B, D) in the summer (A, B) and fall (C, D). 96

65. Experimental catch curves of whitefish from the north basin (A) and channel (B) and commercial catch curves of whitefish from the north basin (C) and channel (D) . . 97

LIST OF APPENDICES

Appendix		Page
A1.	Age compositions of commercially caught walleyes from Grand Rapids (A) and Big Black R. (B), June 1982	99
A2.	Age compositions of commercially caught walleye from Gull Bay, June (A) and Grand Rapids, September (B) . . .	100
A3.	Age compositions of commercially caught walleyes from Big Black R., September (A) and Matheson Is., June (B) .	101
A4.	Age compositions of commercially caught walleyes from Matheson Island, September (A) and Sturgeon Bay, June (B).	102
A5.	Age compositions of commercially caught walleyes from Matheson Is., September (A) and Gimli, June (B)	103
A6.	Age compositions of commercially caught walleyes from Gimli, September (A) and October (B)	104
A7.	Age compositions of commercially caught walleyes from Selkirk in June (A) and September (B)	105
A8.	Age compositions of commercially caught saugers from Berens R., June (A) and Matheson Island, June (B). . . .	106
A9.	Age compositions of commercially caught saugers from Berens R., September (A), and Matheson Island, September (B).	107
A10.	Age compositions of commercially caught saugers from Selkirk, June	108
A11.	Age compositions of commercially caught saugers from Selkirk, September (A) and Gimli, October (B)	109

Appendix Page

A12. Age compositions of commercially caught whitefish, June 1982. A - Warren Landing, B - Big Black River . . 110

A13. Age compositions of commercially caught whitefish, June 1982. A - George Island, B - Grand Rapids 111

A14. Age compositions of commercially caught whitefish from Matheson Island, June 1982 112

Lysack, W. 1983. Data from the 1982 Lake Winnipeg fish stock assessment program. Man. Department of Natural Resources, MS Report No. 83-20, 112pp.

INTRODUCTION

This report presents the results of the fourth annual fish stock assessment program on Lake Winnipeg. This program was initiated in response to a need for a standardized stock monitoring program so that year-to-year comparisons of population dynamics would be valid (Lysack, 1980, 1981, 1982).

The objectives of this study were to:

1. estimate mortality rates of walleye, sauger and whitefish stocks.
2. describe maturity regimes.
3. describe growth regimes.
4. compare mean biomass of fish caught in various mesh sizes among the three major areas of Lake Winnipeg.
5. determine age compositions, mean ages and mortality rates of commercially caught walleyes, saugers and whitefish from the three major areas of Lake Winnipeg and from various management areas.

The annual reports on the Lake Winnipeg fish stock assessment program will be presented in data report format. A more detailed report on long term trends in Lake Winnipeg fish stock dynamics will be prepared in 1984.

METHODS

The two major components of the annual stock assessment program on Lake Winnipeg are experimental netting and commercial sampling.

Experimental netting

Experimental gangs of gillnets were set at thirty three stations on Lake Winnipeg during the summer of 1982 (Fig. 1, Table 1). One gang of gillnets was set at each station for one overnight period (16 - 18 hours). The gang was composed of the following mesh sizes: 7.62 cm (3 in.), 8.26 cm (3.25 in.), 8.89 cm (3.5 in.), 9.53 cm (3.75 in.), 10.16 cm (4 in.) and 10.8 cm (4.25 in.). A 12.70 cm (5 in.) net and a 13.34 cm (5.25 in.) net were added to the gang for sets 15 - 33 (Fig. 1). Each net in the gang was 45.72 m (50 yd.) long and approximately 1.83 (2 yd.) deep.

Walleyes, saugers and whitefish caught in the gangs were processed as described by Lysack (1980).

Commercial sampling

Commercial catches were sampled during the summer and fall commercial fishing seasons (Table 2, Fig. 1). A minimum of 250 fish of each species were sampled during each excursion. Fish were randomly selected from fishermen's catches and were processed in the same manner as experimentally netted fish except that sex and state of maturity were not determined.

Calculations

Routine statistical analyses were performed according to Snedecor and Cochran (1967). Total mortality rates, Z, were calculated according to Robson and Chapman (1961) and were also estimated by least squares regression analysis of the descending limbs of catch curves.

Data were pooled according to the legal minimum commercial mesh size permitted in each major area of Lake Winnipeg: data from experimental gangs 1 - 14 comprised the south basin pool, data from experimental gangs 15 - 23 comprised the channel pool and data from experimental gangs 24 - 33 comprised the north basin pool. The legal minimum commercial mesh sizes permitted in these three major areas are: 3 inch in the south basin, 3.75 inch in the channel and 4.25 inch in the north basin. Commercial sampling data were pooled accordingly: data from Gimli and Selkirk comprised the south basin pool, data from Matheson Is., Sturgeon Bay and Berens River comprised the channel pool and data from Gull Bay, Grand Rapids, Big Black River, George Is. and Warren Landing comprised the north basin pool.

Temporal changes in frequencies of mature fish were described using a logistic model:

$$Y_x = \frac{k}{1 + e^{-b(x - x_o)}}$$

where Y_x = frequency of mature fish among all fish aged x

k = frequency of mature fish among the oldest age groups

x_o = age at inflection point

b = slope

It was assumed that k = 100%. To facilitate fitting a linear regression, data were transformed by:

$$-\log_e \left(\frac{k - y}{y}\right) = -bX_o + bX$$

Values of Y approaching unity or zero were deleted.

Von Bertalanffy growth curves were derived as described by Ricker (1975). The mean biomass per mesh in each major area of the lake was calculated as follows:

$$\text{Mean biomass net}^{-1} = \frac{\Sigma w}{n}$$

where Σw = sum of all the individual weights of fish of a species caught in a specific mesh in all gangs set in an area.

n = number of gangs set in an area.

In cases where not all fish caught in a gang were sampled (Table 3), the number of unsampled fish were added to the number of sampled fish and this sum was multiplied by the mean individual weight to estimate Σw.

RESULTS

Experimental netting

Maturity regimes

The maturity schedules of Lake Winnipeg walleyes (Table 4), saugers (Table 5) and whitefish (Table 6) were used to derive maturity curves of these species from the three major areas of the lake (Table 7, Figs. 2 - 7). Sample sizes of north basin and channel walleye were too small to establish any temporal trends in maturity for these areas.

Growth regimes

Age-specific mean fork lengths and mean weights of walleyes (Table 8), saugers (Table 9) and whitefish (Table 10) from the three major areas of Lake Winnipeg were used to derive length-weight relationship (Table 11, Figs. 8 - 10). Walford plots are listed on Table 12 and depicted in Figs. 11 - 18. Regressions of $\log_e (L_\infty - 1_t)$ versus t (years) (Figs. 19 - 22) are listed on Table 13. Exponential growth curves (Figs. 23 - 25) and von Bertalanffy growth curves (Figs. 26 - 28) are listed on Table 14. Analysis of covariance revealed significant differences ($P = 0.05$) among elevations of walleye exponential growth curves from the three major areas of Lake Winnipeg Table 15. Both slopes and elevations of sauger and whitefish exponential growth curves were not significantly different among lake areas. Regressions of $\log_e (L_\infty - 1_t)$ versus t were considered representative of the von Bertalanffy growth curve since they provided estimates of k and t_o values (Tables 13, 14). Analysis of covariance revealed significant

differences among both slopes and elevations of plots of $\log_e (L_\infty - l_t)$ versus t for walleyes and saugers from the three major areas of Lake Winnipeg (Table 15). A significant difference between the elevations but not the slopes of whitefish von Bertalanffy curves was also revealed (Table 15).

Mesh size effects

Age compositions, sizes, maturity frequencies, biomass and mean numbers of fish caught in the various meshes of the experimental gangs are listed on Tables 16 - 23 and plotted on Figs. 29 - 51.

Age compositions, catch curves and mortality rates

Walleye age frequency distributions determined from experimental catches (Fig. 52) were extremely similar to those determined from commercial samples (Figs. 53 - 55). Note the biomodal character of the channel walleye age composition caused by a mixing of north basin and south basin stocks and reduction of older age classes from summer to fall due to exploitation. The same spatial and temporal trends occurred in the experimental and commercial sauger age distributions (Figs. 56 - 58). Anomalies in the modal age and shape occurred between the experimental and commercial whitefish age compositions from the north basin (Fig. 59, 60). Catch curves derived from the above age distributions (Figs. 61 - 65) were used to estimate mortality and survival rates (Table 24). Appendix A containe age compositions of commercially sampled fish from the various management areas listed on Table 2. Age compositions, mean lengths, mean weights and mean ages of commercially sampled species from the three major areas are listed on Table 25.

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Table 1. 1982 experimental gang locations.

Gang no.	Location*	Date
South basin		
1	Sandy R.	May 26
2	Observation Pt.	May 26
3	Gimli	May 27
4	Willow Pt.	June 2
5	J.B. Pt.	June 3
6	Winnipeg Beach	July 6
7	Red R.	July 6
8	Camp Morton	July 7
9	Balsam Bay	July 8
10	Victoria Beach	July 9
11	Arnes	July 9
12	Elk Is.	July 9
13	Deer Is.	July 13
14	Punk Is.	July 14
Channel		
15	Berens R.	June 4
16	Sturgeon Bay	June 16
17	Dowling Reef	June 18
18	Catfish Creek	June 18
19	Pipestone Rock	July 13
20	Anderson Pt.	July 13
21	Mill Pt.	July 14
22	Moose Is.	July 15
23	Bloodvein Bay	July 15
North basin		
24	Poplar Reef	June 5
25	Big Black	June 5
26	Spider Is.	June 9
27	Mossy Ranges	June 10
28	Warren Landing	June 11
29	Limestone Bay	June 12
30	Deep	June 13
31	Grand Rapids	June 14
32	Gull Bay	June 15
33	Reindeer Is.	June 16

* see Fig. 1.

Table 2. 1982 commercial sampling schedule.

Major area	Location	Species				
		Walleye		Sauger		Whitefish
South basin	Selkirk	June 10	Sept. 10	June 14		
		June 15	Sept. 16			
	Gimli	June 16	Sept. 7	Oct. 14		
			Oct. 7			
Channel	Matheson Is.	June 8	Sept. 17	June 14	Sept. 10	June 15
			Sept. 24			
	Sturgeon Bay	June 9				
	Berens R.			June 8	Sept. 27	
North basin	Grand Rapids	June 11	Sept. 14			June 11(DW)*
	Gull Bay	June 11				
	Big Black R.	June 6	Sept. 8			June 8
	George Is.					June 4(DW)
	Warren Landing					June 10(DW)

* DW = dressed weight

Table 3. Numbers of unsampled fish from various meshes of experimental gangs set in the three major areas of Lake Winnipeg.

Area	Species	Mesh size (inches)							
		3	3.25	3.5	3.75	4	4.25	5	5.25
South	walleye	68	36	0	0	0	0	-	-
Channel	sauger	263	244	246	155	103	26	0	0
	whitefish	7	0	12	0	33	0	0	0
North	sauger	109	109	22	58	76	6	0	0
	whitefish	89	44	30	135	56	0	9	0

Table 4. 1982 maturity schedules of Lake Winnipeg walleyes.

Age (years)	No. immature			No. mature			% mature		
	male	female	total	male	female	total	male	female	total
South basin									
2	4	3	7	0	0	0	0	0	0
3	36	87	123	3	0	3	7.69	0	2.38
4	71	291	362	39	13	52	35.45	4.28	12.56
5	11	81	92	31	17	48	73.81	17.35	34.29
6	3	11	14	24	42	66	88.89	79.25	82.50
7	0	3	3	4	33	37	100.00	91.67	92.50
8	0	0	0	1	19	20	100.00	100.00	100.00
9	0	0	0	1	0				
sex ratio	0.26 : 1			0.83 : 1			0.38 : 1		
Channel*									
3	3	2	5	0	0	0	0	0	0
4	13	24	37	0	0	0	0	0	0
5	3	8	11	5	0	5	62.5	0	31.25
6	3	17	20	9	3	12	75.0	15.0	37.5
7	0	15	15	1	0	1	100.0	0	6.25
8	0	2	2	1	0	1	100.0	0	33.3
9	0	0	0	1	0	1	100.0	0	100.0
sex ratio	0.32 : 1			5.67 : 1			0.55 : 1		
North basin*									
3	0	2	2	0	0	0	0	0	0
4	6	6	12	0	0	0	0	0	0
5	3	8	11	0	0	0	0	0	0
6	10	39	49	8	0	8	44.44	0	14.04
7	18	109	127	16	0	16	47.06	0	11.19
8	1	29	30	6	4	10	85.71	12.12	25.0
9	1	2	3	4	5	9	80.00	71.43	75.0
10	0	1	1	0	0	0	0	0	0
sex ratio	0.20 : 1			3.78 : 1			0.36 : 1		

* sample sizes from these areas were too small to establish any trends in maturation.

Table 5. 1982 maturity schedules for Lake Winnipeg saugers.

Age (years)	No. immature			No. mature			% mature		
	male	female	total	male	female	total	male	female	total
South basin									
1	0	5	5	0	0	0	0	0	0
2	45	43	88	1	0	1	2.17	0	1.12
3	154	164	318	8	0	8	4.94	0	2.45
4	40	102	142	25	7	32	38.46	6.42	18.39
5	14	14	28	29	33	62	67.44	70.21	68.89
6	3	9	12	32	64	96	91.43	87.67	88.89
7	0	3	3	10	47	57	100.00	94.00	95.00
8				0	4	4		100.00	100.00
9				0	1	1			
sex ratio	0.75 : 1			0.67 : 1			0.73 : 1		
Channel									
1	1	0	1	0	0	0	0	0	0
2	20	15	35	0	1	1	0	6.25	2.78
3	24	19	43	1	0	1	4.0	0	2.27
4	25	28	53	2	3	5	7.41	9.68	8.62
5	11	8	19	29	9	38	72.5	52.94	66.67
6	10	9	19	53	37	90	84.13	80.43	82.57
7	4	2	6	80	66	146	95.24	97.06	96.05
8	0	1	1	74	94	168	100.0	98.95	99.41
9	0	1	1	56	88	144	100.0	98.88	99.31
10	0	1	1	18	29	47	100.0	96.67	97.92
11	0	0	0	4	12	16	100.0	100.0	100.0
12	0	0	0	1	3	4	100.0	100.0	100.0
sex ratio	1.13 : 1			0.92 : 1			0.97 : 1		
North basin									
2	0	1	1	0	0	0	0	0	0
3	1	1	2	0	0	0	0	0	0
4	2	0	2	0	0	0	0	0	0
5	1	5	6	6	3	9	85.71	37.5	60.0
6	1	17	18	9	20	29	90.0	54.05	61.7
7	3	21	24	43	95	138	93.48	81.9	85.19
8	2	4	6	80	175	255	97.56	97.77	97.7
9	1	1	2	73	143	216	98.65	99.31	99.08
10	0	1	1	28	51	79	100.0	98.08	98.75
11	0	0	0	9	28	37	100.0	100.0	100.0
12	0	0	0	7	10	17			
13	0	0	0	1	1	2			
14	0	0	0	0	2	2			
sex ratio	0.21 : 1			0.48 : 1			0.46 : 1		

Table 6. 1982 maturity schedules of Lake Winnipeg whitefish.

Age (years)	No. immature			No. mature			% mature		
	male	female	total	male	female	total	male	female	total
Channel									
3	11	11	22	0	0	0	0	0	0
4	68	58	126	10	23	33	12.82	28.40	20.75
5	28	15	43	61	77	138	68.54	83.70	76.24
6	11	13	24	72	105	177	86.75	88.98	88.06
7	3	1	4	21	65	86	87.5	98.48	95.56
8	1	0	1	6	9	15	85.71	100.0	93.75
9	0	0	0	1	2	3	100.0	100.0	100.0
10	0	0	0	1	0	1			
sex ratio	1.24 : 1			0.61 : 1			0.76 : 1		
North basin									
3	37	41	78	0	0	0	0	0	0
4	213	229	442	24	44	68	10.13	16.12	13.33
5	76	52	128	79	119	198	50.97	69.59	60.74
6	18	11	29	114	177	321	88.89	94.15	91.71
7	10	0	10	74	75	149	88.10	100.0	93.71
8	2	0	2	5	14	19	71.43	100.0	90.48
9	0	0	0	4	2	6	100.0	100.0	100.0
10	0	0	0	1	3	4			
11	0	0	0	0	1	1			
sex ratio	1.07 : 1			0.76 : 1			0.89 : 1		

Table 7. 1982 maturity curves of Lake Winnipeg walleyes, saugers and whitefish.

Species	Area	Sex	Maturity curve*	R	F ratio and d.f.	Age at 50% mature (years)
Walleye	South basin	Male	Y = - 6.891 + 1.533X	0.992	128.22(1,2)	4.50
		Female	Y = -10.913 + 1.942X	0.985	66.07(1,2)	5.62
		Combined	Y = - 8.420 + 1.594X	0.995	279.44(1,3)	5.28
	Channel	Male	———			
		Female	———			
		Combined	———			
	North basin	Male	———			
		Female	———			
		Combined	———			
Sauger	South basin	Male	Y = - 7.243 + 1.604X	0.991	168.43(1,3)	4.52
		Female	Y = - 8.846 + 1.740X	0.937	14.34(1,2)	5.08
		Combined	Y = - 7.930 + 1.620X	0.988	164.92(1,4)	4.90
	Channel	Male	Y = - 8.285 + 1.654X		45.29(1,3)	5.01
		Female	Y = - 6.074 + 1.269X	0.947	26.25(1,3)	4.79
		Combined	Y = - 7.487 + 1.507X	0.967	58.33(1,4)	4.97
	North basin	Male	Y = - 1.417 + 0.616X	0.973	34.92(1,2)	2.30
		Female	Y = - 8.009 + 1.422X	0.970	31.53(1,2)	5.63
		Combined	Y = 5.752 + 1.130X	0.934	13.58(1,2)†	5.09
Whitefish	North basin	Male	Y = - 5.818 + 1.200X	0.750	2.58(1,2)†	4.85
		Female	Y = -10.417 + 2.214X	0.998	212.11(1,1)	4.71
		Combined	Y = - 7.711 + 1.569X	0.958	22.39(1,2)	4.91
	Channel	Male	Y = - 6.307 + 1.269X	0.907	9.24(1,2)†	4.97
		Female	Y = - 6.914 + 1.574X	0.971	32.78(1,2)	4.39
		Combined	Y = - 6.510 + 1.406X	0.966	28.33(1,2)	4.63

*$Y = -\log_e \left(\frac{100 - Y_i}{Y_i}\right)$ where Y_i = frequency of mature fish in age class i, X = age (years)

† non-significant at P = 0.05

Table 8. Age-specific mean fork lengths and mean weights of walleyes from the north basin, channel and south basin of Lake Winnipeg, 1982.

Area	Age (years)	No. fish	Mean length (mm)	1 S.E.	Mean weight (gm)	1 S.E.
North basin	3	2	269.00	27.00	215.00	65.00
	4	12	338.00	22.70	464.17	104.63
	5	11	341.27	13.89	466.36	59.85
	6	57	379.61	4.19	643.16	22.66
	7	143	413.96	2.80	858.67	19.75
	8	40	435.35	5.65	1060.75	46.80
	9	12	452.83	8.30	1065.00	57.77
	10	1	510.00	-	1390.00	-
Channel	3	5	310.40	10.32	328.00	29.73
	4	37	327.03	4.24	397.03	15.56
	5	16	355.88	10.88	523.13	49.12
	6	32	397.69	4.82	738.75	26.44
	7	16	439.25	8.61	1090.00	65.76
	8	3	463.33	22.52	1300.00	138.92
	9	1	348.00	-	580.00	-
South basin	2	7	271.71	30.26	284.29	89.70
	3	126	328.06	3.55	446.11	13.71
	4	414	344.68	1.95	522.87	9.12
	5	140	391.07	3.89	739.50	22.44
	6	80	443.19	5.40	1063.25	36.66
	7	40	478.00	6.45	1340.00	50.21
	8	20	489.10	7.39	1459.00	77.92
	9	1	448.00	-	1120.00	-

Table 9. Age-specific mean fork lengths and mean weights of saugers from the north basin, channel and south basin of Lake Winnipeg, 1982.

Area	Age (years)	No. fish	Mean length (mm)	1 S.E.	Mean weight (gm)	1 S.E.
North basin	2	1	162.00	-	80.00	-
	3	2	237.00	5.00	140.00	0
	4	2	223.00	3.00	115.00	15.00
	5	15	300.53	7.91	301.33	24.84
	6	47	328.00	2.91	410.43	13.83
	7	162	336.73	1.93	467.90	8.74
	8	261	359.74	1.55	589.00	8.28
	9	218	376.18	1.71	691.93	9.30
	10	80	393.48	2.95	815.25	20.94
	11	37	409.19	5.54	965.41	36.89
	12	17	420.00	6.68	1020.00	58.39
	13	2	444.00	18.00	1170.00	100.00
	14	2	439.00	11.00	1270.00	70.00
Channel	1	1	180.00	-	30.00	-
	2	36	211.44	2.92	68.06	3.67
	3	44	232.45	2.73	93.86	4.61
	4	58	268.79	3.05	171.21	7.26
	5	57	296.11	3.01	257.37	8.43
	6	109	317.96	2.50	329.72	8.01
	7	152	326.97	1.93	387.96	8.35
	8	169	353.88	1.84	537.72	9.74
	9	145	372.48	2.37	647.59	12.58
	10	48	397.58	3.77	815.63	27.54
	11	16	404.38	8.37	880.31	56.91
	12	4	429.00	14.75	1135.00	78.37
	13	3	449.33	6.36	1263.33	108.37
South basin	1	5	116.80	6.09	23.00	2.00
	2	89	211.21	1.80	102.42	2.84
	3	326	225.70	1.16	131.15	2.59
	4	174	276.29	2.02	242.76	6.24
	5	90	311.80	2.70	346.11	10.13
	6	108	331.24	2.61	426.39	12.55
	7	60	347.10	3.88	505.50	19.51
	8	4	364.00	21.01	587.50	90.59
	9	1	380.00	-	710.00	-

Table 10. Age-specific mean fork lengths and mean weights of whitefish from the north basin and channel of Lake Winnipeg, 1982.

Area	Age (years)	No. fish	Mean length (mm)	1 S.E.	Mean weight (gm)	1 S.E.
North basin	3	78	291.13	2.73	347.18	9.99
	4	510	321.33	1.31	486.56	6.28
	5	326	367.23	1.70	728.59	10.04
	6	350	396.90	1.28	934.57	9.08
	7	159	406.70	1.90	1021.64	14.28
	8	21	413.81	3.71	1091.43	33.81
	9	6	439.00	13.94	1325.00	140.87
	10	4	412.00	45.15	1100.00	324.94
	11	1	522.00	-	2010.00	-
Channel	3	22	296.82	6.66	377.95	22.32
	4	159	330.04	2.29	563.96	11.66
	5	181	372.94	1.94	798.67	11.94
	6	201	398.85	1.62	965.02	13.16
	7	90	414.49	2.24	1221.22	20.30
	8	16	427.50	8.16	1291.25	53.23
	9	3	461.33	25.67	1600.00	195.19
	10	1	438.00	-	1300.00	-

Table 11. Age-specific mean length-weight curves of walleyes, saugers and whitefish from the three major areas of Lake Winnipeg, 1982.

Species	Area	$\log_e$ mean weight = a + b · $\log_e$ mean length	Correlation coefficient	Test F ratio and d.f.
Walleye	North	$\log_e Y = -11.288 + 2.988 \log_e X$	0.995	577.16 (1, 6)
	Channel	$\log_e Y = -13.244 + 3.325 \log_e X$	0.991	267.85 (1, 5)
	South	$\log_e Y = -10.134 + 2.808 \log_e X$	0.999	2,884.75 (1, 6)
Sauger	North	$\log_e Y = -11.218 + 2.993 \log_e X$	0.985	356.99 (1,11)
	Channel	$\log_e Y = -17.613 + 4.065 \log_e X$	0.999	7,198.85 (1,11)
	South	$\log_e Y = -10.821 + 2.909 \log_e X$	0.998	1,395.24 (1, 7)
Whitefish	North	$\log_e Y = -11.540 + 3.072 \log_e X$	0.997	1,272.71 (1, 7)
	Channel	$\log_e Y = -12.278 + 3.203 \log_e X$	0.998	1,757.63 (1, 6)

Table 12. Walford curves of walleyes, saugers and whitefish from the three major areas of Lake Winnipeg, 1982.

Species	Area	Walford curve $L_{t+1} = a + b \cdot L_t$	L_∞ (mm)	Age classes deleted	Correlation coefficient	Test F ratio and d.f.
Walleye	North basin	Y = 70.603 + 0.904 X	735.45	-	0.935	34.88(1,5)
		Y =120.807 + 0.763 X	509.73	3-5,9-10	0.997	358.86(1,2)
	Channel	Y =232.534 + 0.408 X	392.79	-	0.463	1.09(1,4)
		Y = 10.728 + 1.504 X	∞	8-9	0.982	81.41(1,3)
		Y =120.292 + 0.788 X	567.42	3-5,8- 9	0.989	43.30(1,1)
	South basin	Y =136.154 + 0.717 X	481.11	-	0.921	28.09(1,5)
		Y =145.651 + 0.736 X	551.71	2-4,8- 9	0.977	41.14(1,2)
		Y =234.282 + 0.539 X	508.20	2-5,8- 9	0.985	31.87(1,1)
Sauger	North basin	Y = 87.623 + 0.806 X	451.67	-	0.955	104.73(1,10)
		Y =120.168 + 0.726 X	438.57	2-4	0.968	119.32(1,8)
		Y =134.361 + 0.678 X	417.27	2-4,10-12	0.963	76.78(1,6)
	Channel	Y = 39.120 + 0.947 X	738.11	-	0.995	1101.39(1,10)
		Y = 46.414 + 0.919 X	573.01	1-2,11-13	0.991	394.72(1,7)
		Y = 61.416 + 0.876 X	495.29	1-3,11-13	0.989	270.35(1,6)
	South basin	Y =108.118 + 0.724 X	391.73	-	0.968	89.66(1,6)
		Y =109.073 + 0.731 X	405.48	1-3	0.994	344.97(1,4)
		Y =118.492 + 0.696 X	389.78	1-3,6-7	0.996	351.73(1,3)
Whitefish	North basin	Y = 88.827 + 0.843 X	565.78	-	0.744	7.43(1,6)
		Y =143.846 + 0.664 X	428.11	10-11	0.918	26.89(1,5)
	Channel	Y =128.016 + 0.721 X	458.84	-	0.940	38.05(1,5)
		Y =105.410 + 0.781 X	481.32	8-10	0.986	108.31(1,3)
		Y =162.965 + 0.643 X	445.26	3-4, 8-10	0.998	577.79(1,2)

Table 13. Relationship of $\log_e (L_\infty - l_t)$ and t (years) for walleyes, saugers and whitefish, 1982.

Species	Area	$\log_e (L_\infty - l_t) = a - b \cdot t$	Age range (years)	R	Test F ratio and d.f.
Walleye	North basin	$\log_e (509.73 - l_t) = 6.198 - 0.234\ t$	3 - 9	0.990	242.82(1, 5)
	Channel	$\log_e (567.42 - l_t) = 6.211 - 0.189\ t$	3 - 8	0.981	100.78(1, 4)
		$\log_e (567.42 - l_t) = 6.399 - 0.218\ t$	4 - 8	0.993	222.91(1, 3)
	South basin	$\log_e (508.20 - l_t) = 6.126 - 0.315\ t$	2 - 9	0.861	17.26(1, 6)
		$\log_e (508.20 - l_t) = 6.586 - 0.430\ t$	2 - 8	0.969	77.60(1, 5)
Sauger	North basin	$\log_e (438.57 - l_t) = 6.241 - 0.253\ t$	2 - 12	0.984	266.44(1, 9)
	Channel	$\log_e (495.29 - l_t) = 6.020 - 0.147\ t$	1 - 13	0.980	270.79(1,11)
	South basin	$\log_e (389.78 - l_t) = 6.133 - 0.375\ t$	1 - 9	0.976	138.23(1, 7)
Whitefish	North basin	$\log_e (428.11 - l_t) = 6.449 - 0.480\ t$	3 - 8	0.994	313.69(1, 4)
	Channel	$\log_e (445.26 - l_t) = 6.388 - 0.429\ t$	3 - 8	0.996	501.38(1, 4)

Table 14. Exponential and von Bertalanffy growth curves of walleyes, saugers and whitefish from the three major areas of Lake Winnipeg, 1982.

Species	Area	Growth curves						
		Exponential			Von Bertalanffy parameters			
		$\log_e$ length = a + b · $\log_e$ age	Age range (years)	R	L_∞	k	t_o	R
Walleye	North basin	Y = 5.129 + 0.455 X	3 - 9	0.984	509.73	0.234	+0.154	0.990
	Channel	Y = 5.221 + 0.432 X	3 - 8	0.979	567.42	0.218	-0.266	0.993
	South basin	Y = 5.290 + 0.437 X	2 - 8	0.990	508.20	0.430	-0.827	0.969
Sauger	North basin	Y = 5.091 + 0.383 X	5 - 14	0.996	438.57	0.253	+0.622	0.984
	Channel	Y = 5.112 + 0.369 X	1 - 13	0.990	495.29	0.147	-1.257	0.980
	South basin	Y = 4.869 + 0.513 X	1 - 9	0.983	389.78	0.375	+0.446	0.976
Whitefish	North basin	Y = 5.278 + 0.371 X	3 - 11	0.947	428.11	0.480	-0.811	0.994
	Channel	Y = 5.391 + 0.391 X	3 - 9	0.994	445.26	0.429	+0.675	0.996

Table 15. Covariance analyses of walleye, sauger and whitefish growth curves.

Species	Growth curve			
	Exponential		von Bertalanffy	
	Slopes F ratio and d.f.	Elevations F ratio and d.f.	Slopes F ratio and d.f.	Elevations F ratio and d.f.
Walleye	0.09(2, 14)	26.73(2, 16)*	14.47(2, 14)*	18.17(2, 16)*
Sauger	1.72(2, 25)	0.05(2, 27)	41.25(2, 27)*	29.85(2, 29)*
Whitefish	0.24(1, 10)	3.89(1, 11)	2.31(1, 8)	12.84(1, 9)*

* significant at P = 0.05

Table 16. Mesh size effects on south basin walleyes.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. sampled fish	307	189	132	91	69	40	0	0
no. unsampled fish	68	36	0	0	0	0	0	0
total no. fish	375	225	132	91	69	40		
no. immature	253	160	86	62	32	8		
% immature	82.41	84.66	65.15	68.13	46.38	20.00		
mean length (mm)	322.43	352.23	399.78	406.20	441.65	460.75		
mean weight (gm)	424.58	552.59	798.48	861.76	1078.99	1219.25		
Age (years)	Frequency (%)							
2	0.98	0.53	0.76	2.20				
3	20.20	16.93	6.82	24.18	1.45			
4	63.19	60.85	41.67	34.07	21.74	10.00		
5	11.73	13.23	27.27	19.78	24.64	20.00		
6	3.58	6.35	12.12	9.89	33.33	22.50		
7	0.33	1.59	9.09	6.59	10.14	27.50		
8		0.53	2.27	3.30	8.70	17.50		
9						2.50		
Mean age	3.98	4.15	4.80	4.40	5.50	6.30		
Mean biomass net^{-1} (kg)	11.37	8.88	7.53	5.60	5.32	3.48		
Mean no. fish net^{-1}	26.79	16.07	9.43	6.50	4.93	2.86		

Table 17. Mesh size effects on channel walleyes.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. fish	35	27	15	15	11	3	2	2
no. immature	33	23	10	11	8	2	0	0
% immature	94.29	85.19	66.67	73.33	72.73	66.67	0	0
mean length (mm)	335.83	364.81	371.73	388.53	436.00	457.33	433.00	398.00
mean weight (gm)	451.43	571.85	640.67	697.33	1050.91	1226.67	1040.00	815.00
Age (years)	Frequency (%)							
3	8.57	7.41						
4	57.14	44.44	26.67	6.67				
5	11.43	11.11	26.67	20.00	18.18			
6	11.43	25.93	33.33	73.33	27.27	33.33	50.00	
7	8.57	7.41	13.33		45.45	66.67	50.00	50.00
8	2.86	3.70			9.09			
9								50.00
mean age (years)	4.63	4.93	5.33	5.67	6.45	6.67	6.5	8.0
mean$_{net^{-1}}$ biomass (kg)	1.76	1.72	1.07	1.16	1.28	0.41	0.23	0.18
mean$_{net^{-1}}$ no. fish	3.89	3	1.67	1.67	1.22	0.33	0.22	0.22

Table 18. Mesh size effects on north basin walleyes.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. fish	45	33	70	41	59	16	9	5
no. immature	39	30	55	38	49	12	8	4
% immature	86.67	90.91	78.57	92.68	83.05	75.00	88.88	80.00
mean length (mm)	381.64	369.45	407.69	410.20	418.92	421.13	443.78	474.00
mean weight (gm)	672.00	600.61	813.29	835.85	907.97	964.38	1164.44	1288.00
Age (years)	Frequency (%)							
3	2.22	3.03						
4	8.89	15.15	2.86				11.11	
5	15.56	6.06	1.43		1.69		11.11	
6	22.22	24.24	21.43	26.83	16.95	12.5	44.44	
7	42.22	45.45	51.43	63.41	59.32	37.5	11.11	40.0
8	2.22	3.03	21.43	9.76	18.64	31.25	22.22	40.0
9	4.44	3.03	1.43		3.39	18.75		20.0
10	2.22							
mean age (years)	6.29	6.15	6.91	6.83	7.05	7.56	6.22	7.80
mean biomass net^{-1} (kg)	3.02	1.98	5.69	3.43	5.36	1.54	1.05	0.64
mean no. fish net^{-1}	4.5	3.3	7.0	4.1	5.9	1.6	0.9	0.5

Table 19. Mesh size effects on south basin saugers.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. fish	203	188	143	108	132	83	0	0
no. immature	101	127	103	79	113	73		
% immature	49.75	67.55	72.03	73.15	85.61	87.95		
mean length (mm)	287.26	271.89	259.24	259.61	249.26	242.05		
mean weight (gm)	292.59	255.21	225.63	230.97	194.70	175.06		
Age (years	Frequency (%)							
1		1.60		1.85				
2	4.93	8.51	10.49	15.74	11.36	19.28		
3	21.67	34.04	43.36	38.89	53.79	51.81		
4	22.66	20.74	21.68	17.59	21.21	13.25		
5	21.18	11.70	7.69	6.48	0.76	7.23		
6	18.72	14.89	11.89	8.33	8.33	6.02		
7	10.34	7.45	4.90	10.19	4.55	1.20		
8	0.49	1.06		0.93		0		
9						1.20		
mean age (years)	4.60	4.12	3.82	3.82	3.55	3.38		
mean biomass net^{-1} (kg)	4.24	3.43	2.30	1.78	1.84	1.04		
mean no. fish net^{-1}	14.5	13.4	10.2	7.7	9.4	5.9		

Table 20. Mesh size effects on channel saugers.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. unsampled fish	263	244	246	155	103	26	0	0
no. sampled fish	207	182	129	115	104	67	24	14
total no. fish	470	426	375	270	207	93	24	14
no. immature	44	35	25	38	22	14	0	1
% immature	21.26	19.23	19.38	33.04	21.15	20.90	0	7.1
mean length (mm)	318.04	328.08	331.40	329.72	336.90	335.28	364.33	344.43
mean weight (gm)	349.32	408.02	360.54	466.00	509.42	531.34	690.42	552.86
Age (years)	Frequency (%)							
1					0.96			
2	4.83	1.10	2.33	7.83	5.77	8.96		
3	4.35	8.24	3.88	7.83	2.88	4.48		
4	4.83	7.69	9.30	6.96	8.65	7.46		
5	9.66	3.30	3.88	6.96	11.54	7.46	4.17	
6	22.71	15.93	10.08	4.35	6.73	7.46	12.50	
7	27.05	25.27	12.40	10.43	10.58	7.46	8.33	28.57
8	17.87	21.43	26.36	19.13	15.38	16.42	16.67	42.86
9	7.25	14.29	24.03	26.96	22.12	19.40	12.50	21.43
10	0.48	1.65	6.98	6.09	12.50	11.94	25.00	7.14
11	0.97	0.55	0.78	2.61	2.88	4.48	12.50	
12		0.55		0		2.99	4.17	
13				0.87		1.49	4.17	
mean age (years)	6.40	6.76	7.26	6.98	7.07	7.25	8.92	8.07
mean $_{net^{-1}}$ biomass (kg)	18.2	19.3	19.2	14.0	11.7	5.5	1.8	0.9
mean no. fish net^{-1}	52.2	47.3	41.67	30.0	11.56	10.3	2.67	1.56

Table 21. Mesh size effects on north basin saugers.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. unsampled fish	109	109	22	58	76	6	0	0
no. sampled fish	162	126	150	153	119	87	24	25
total no. fish	271	235	172	211	195	93	24	25
no. immature	27	10	8	9	2	1	1	4
% immature	16.67	7.94	5.33	5.88	1.68	1.15	4.17	16.00
mean length (mm)	338.62	349.56	369.32	362.89	377.36	389.52	387.33	362.80
mean weight (gm)	472.10	529.68	645.87	618.10	729.66	795.40	802.08	719.20
Age (years)	Frequency (%)							
2								4.00
3		0.79						4.00
4	0.62				0.84			
5	3.09	4.76		1.31	0.84			4.00
6	12.96	11.11	3.33	2.61	1.68	1.15		
7	30.86	24.60	14.00	16.99	10.08	12.64	25.00	20.00
8	22.22	26.19	39.33	39.87	29.41	28.74	25.00	24.00
9	25.31	22.22	29.33	24.18	31.09	27.59	16.67	12.00
10	4.32	6.35	8.00	11.11	17.65	16.09	4.17	
11	0.62	3.17	3.33	1.96	5.88	6.90	25.00	20.00
12		0.79	2.67	1.96	2.52	4.60		8.00
13						1.15		4.00
14						1.15	4.17	
mean age (years)	7.67	7.82	8.45	8.34	8.75	8.97	9.00	8.48
mean biomass net^{-1} (kg)	12.8	12.4	11.1	13.0	14.2	7.4	1.9	1.8
mean no. fish net^{-1}	27.1	23.5	17.2	21.1	19.5	9.3	2.4	2.5

Table 22. Mesh size effects on channel whitefish.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. unsampled fish	7	0	12	0	33	0	0	0
no. sampled fish	66	96	134	135	109	82	43	8
total no. fish	73	96	146	135	142	82	43	8
no. immature	37	59	47	47	15	10	4	1
% immature	56.06	61.46	35.07	34.81	13.76	12.20	9.30	12.5
mean length (mm)	343.91	349.25	371.70	372.93	391.43	395.54	413.86	421.50
mean weight (gm)	656.29	663.65	804.48	822.37	924.04	969.27	1117.44	1261.25
Age (years)	Frequency (%)							
3	15.15	8.33	0.75	1.48	0.92			
4	37.88	44.79	26.12	25.19	13.76	8.54		
5	24.24	17.71	30.60	34.07	29.36	26.83	16.28	
6	18.18	21.88	26.87	27.41	33.94	39.02	55.81	25.00
7	3.03	6.25	11.19	8.89	18.35	24.39	25.58	50.00
8		1.04	4.48	2.22	2.75	1.22	2.33	12.50
9	1.52			0.74	0.92			
10								12.50
mean age (years)	4.62	4.76	5.35	5.27	5.67	5.83	6.14	7.25
mean biomass net^{-1} (kg)	5.3	7.1	13.1	12.3	14.6	8.8	5.3	1.1
mean no. fish net^{-1}	8.1	10.7	16.2	15.0	15.8	9.1	4.8	0.9

Table 23. Mesh size effects on north basin whitefish.

Parameter	Mesh size (inches)							
	3	3.25	3.5	3.75	4	4.25	5	5.25
no. unsampled fish	89	44	30	135	56	0	9	0
no. sampled fish	185	156	241	260	255	179	95	84
total no. fish	274	200	271	395	311	179	104	84
no. immature	159	128	155	139	75	29	2	2
% immature	85.95	82.05	64.32	53.46	29.41	16.20	2.11	2.38
mean length (mm)	309.37	315.97	347.02	358.08	378.96	388.83	408.86	417.14
mean weight (gm)	435.50	468.96	624.85	685.77	796.78	887.93	1038.32	1145.12
Age (years)	Frequency (%)							
3	21.62	10.90	4.15	3.85	0.39			
4	61.62	62.18	48.96	40.77	22.35	8.94	2.11	
5	10.81	17.31	26.14	24.62	31.37	29.61	13.68	7.14
6	5.41	7.69	12.03	19.62	30.20	40.78	51.58	58.33
7	0.54	0.64	7.05	9.23	14.12	17.32	29.47	25.00
8		0.64	1.66	1.54	1.18	2.23	2.11	3.57
9				0.38	0.39	0.56	1.05	2.38
10		0.64				0.56		2.38
11								1.19
mean age (years)	4.02	4.30	4.74	4.96	5.40	5.78	6.19	6.48
mean biomass net^{-1} (kg)	11.9	9.4	16.9	27.1	24.8	15.9	10.8	9.6
mean no. fish net^{-1}	27.4	20.0	27.1	39.5	31.1	17.9	10.4	8.4

Table 24. Mortality and survival rates of walleyes, saugers and whitefish from the three major areas of Lake Winnipeg, 1982.

Species	Area	Robson-Chapman			Regression		
		Z	A	S ± 2 S.E.	Z	A	S
Experimental							
Walleye	North	1.405	.7546	-.1488 <.2454 <.6396	1.199	.6985	.3015
	Channel	1.609	.7999	-.1751 <.2001 <.5753	1.039	.6462	.3538
	South	0.849	.5721	-.2617 <.4279 <.5941	0.721	.5137	.4863
Sauger	North	0.952	.6141	.1481 <.3859 <.6238	0.952	.6140	.3860
	Channel	1.120	.6737	.0170 <.3263 <.6356	1.016	.6380	.3620
	South	1.227	.7055	-.0622 <.2945 <.6511	1.531	.7837	.2163
Whitefish	North	1.589	.7958	-.1946 <.2042 <.6031	1.167	.6887	.3113
	Channel	1.686	.8148	-.1678 <.1852 <.5382	1.345	.7395	.2605
Commercial summer							
Walleye	North	1.904	.8510	-.1064 <.1490 <.4044	2.022	.8676	.1324
	Channel	1.044	.6479	.1127 <.3521 <.5916	1.054	.6515	.3485
	South	0.903	.5948	.1991 <.4052 <.6113	0.665	.4857	.5143
Sauger	Channel	0.956	.6155	.0991 <.3845 <.6698	0.910	.5975	.4025
	South	1.514	.7800	.0323 <.2200 <.4724	1.555	.7888	.2112
Whitefish	North	2.137	.8820	-.0714 <.1180 <.3075	2.255	.8951	.1049
	Channel	1.589	.7959	-.0534 <.2041 <.4616	0.815	.5574	.4426
Commercial fall							
Walleye	North	1.578	.7937	-.1184 <.2063 <.5311	1.642	.8064	.1936
	Channel	1.150	.6835	.0272 <.6835 <.6059	1.242	.7112	.2888
	South	1.058	.6528	.1012 <.3472 <.5933	0.891	.5898	.4102
Sauger	Channel	1.552	.7882	-.0195 <.2118 <.4431	1.723	.8215	.1785
	South	1.850	.8428	-.0977 <.1572 <.4121	1.433	.7614	.2386

Table 25. Age compositions, mean lengths, mean weights and mean weighted ages of commercially sampled species from the three major areas of Lake Winnipeg, 1982. Numbers in parentheses are percentage frequencies.

Species	Area	Season	Age (years)													Mean length (mm)	Mean weight (gm)	Mean age (years)
			1	2	3	4	5	6	7	8	9	10	11	12	13	14			
Walleye	North	Summer					39 (5.2)	218 (29.07)	290 (36.67)	171 (22.80)	29 (3.87)	3 (0.4)					443.06	1097.04	6.92
		Fall			2 (0.4)	35 (7.00)	158 (31.60)	202 (40.40)	80 (16.00)	20 (4.00)	1 (0.2)	1 (0.2)					442.01	1155.96	5.80
	Channel	Summer			37 (7.41)	152 (30.46)	75 (15.03)	132 (26.45)	87 (17.43)	15 (3.01)	1 (0.20)						388.31	731.16	5.26
		Fall			62 (12.40)	127 (25.40)	71 (14.20)	83 (16.60)	96 (19.20)	53 (10.60)	7 (1.40)	1 (0.20)					431.60	1084.04	5.43
	South	Summer		1 (0.13)	339 (45.26)	293 (39.12)	29 (3.87)	44 (5.87)	17 (2.27)	22 (2.94)	3 (0.40)	1 (0.13)					360.63	587.80	3.91
		Fall		49 (4.90)	558 (55.80)	282 (28.20)	48 (4.80)	42 (4.20)	10 (1.00)	9 (0.9)	1 (0.1)	1 (0.1)					383.19	602.11	3.55
Sauger	Channel	Summer				1 (0.13)	2 (0.27)	22 (2.94)	65 (8.69)	214 (28.61)	217 (29.01)	131 (17.51)	65 (8.69)	22 (2.94)	7 (0.94)	2 (0.27)	361.72	589.30	8.92
		Fall			21 (4.20)	102 (20.40)	171 (34.20)	157 (31.40)	44 (8.80)	4 (0.80)	1 (0.20)						328.37	427.22	5.23
	South	Summer				18 (7.23)	51 (20.48)	31 (12.45)	61 (24.50)	67 (26.91)	18 (7.23)	2 (0.80)	1 (0.40)				310.96	332.01	6.70
		Fall	3 (0.6)	46 (9.20)	310 (62.00)	123 (24.60)	11 (2.20)	6 (1.20)	1 (0.20)								296.96	330.56	3.23
Whitefish	North	Summer				11 (1.10)	109 (10.9)	465 (46.5)	364 (36.4)	47 (4.7)	3 (0.3)	1 (0.1)					407.72	883.27*	6.34
	Channel	Summer				11 (4.4)	39 (15.6)	102 (40.8)	78 (31.2)	19 (7.6)	1 (0.4)						411.67	1082.16	6.23

* dressed weight

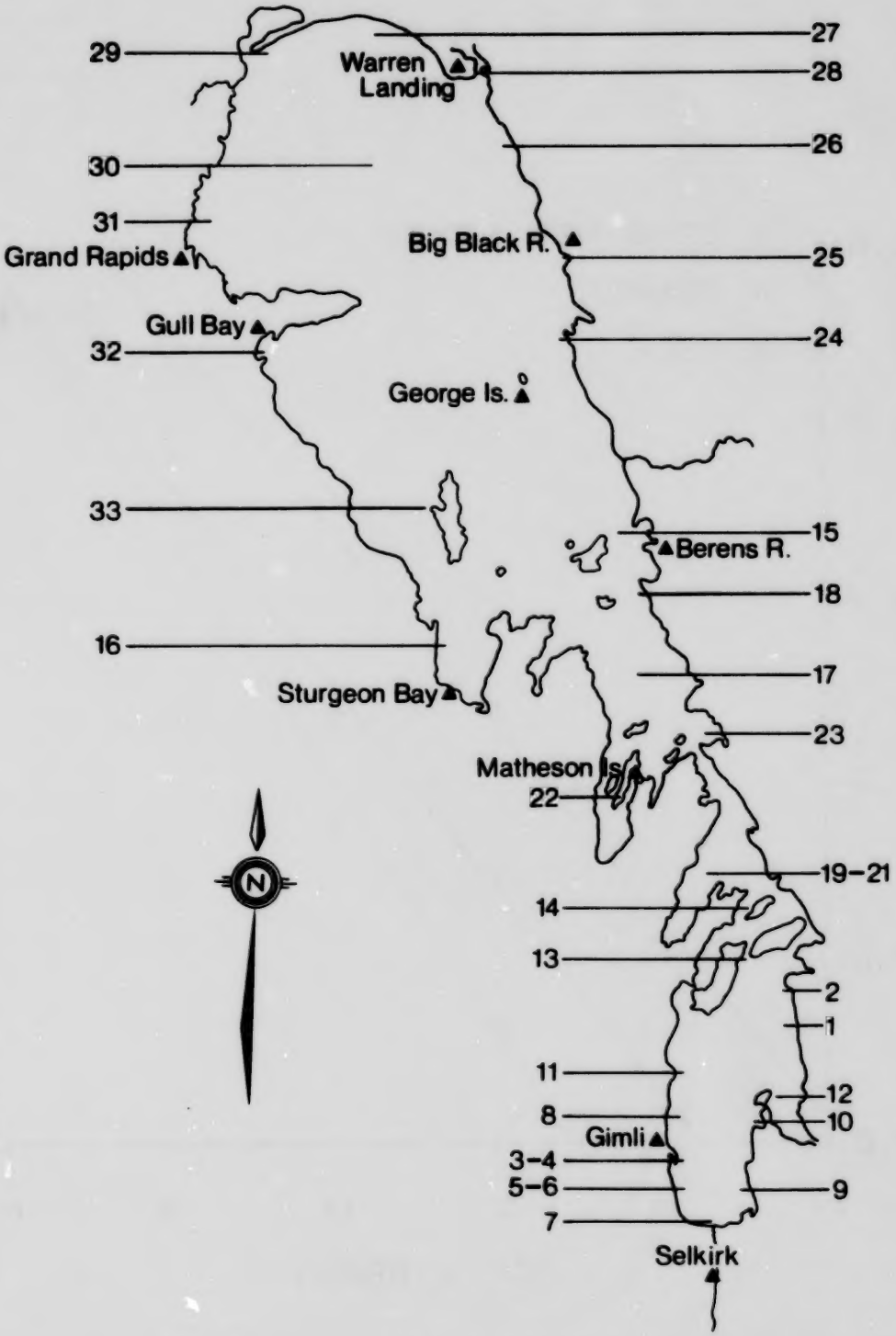

Fig. 1. Locations of sampling stations on Lake Winnipeg. Numbers denote chronological order of experimental gang sets. Triangles indicate locations of commercial packing facilities.

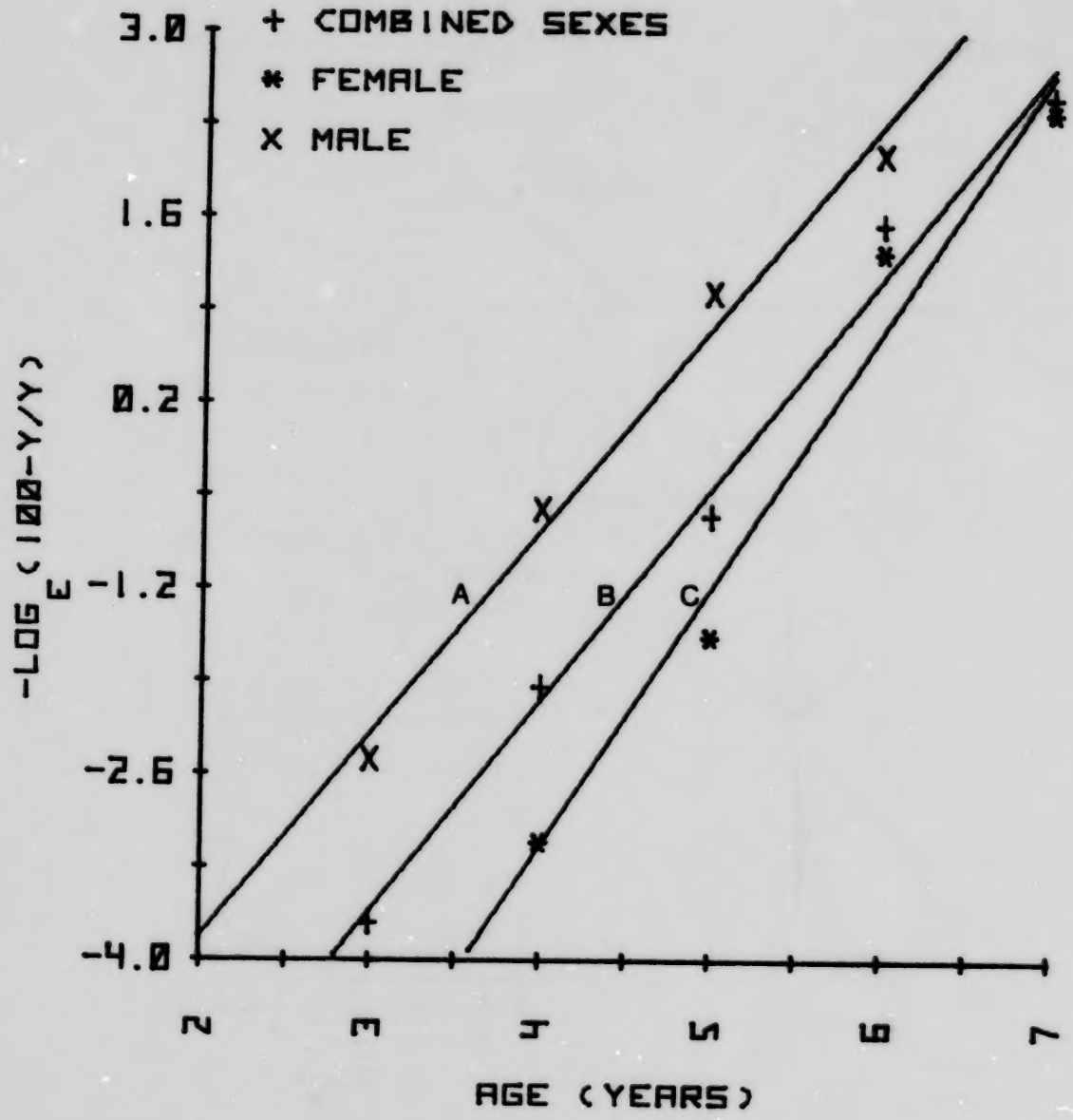

Fig. 2. Maturity curves of south basin walleyes. Curve A - males, curve B - combined sexes, curve C - females.

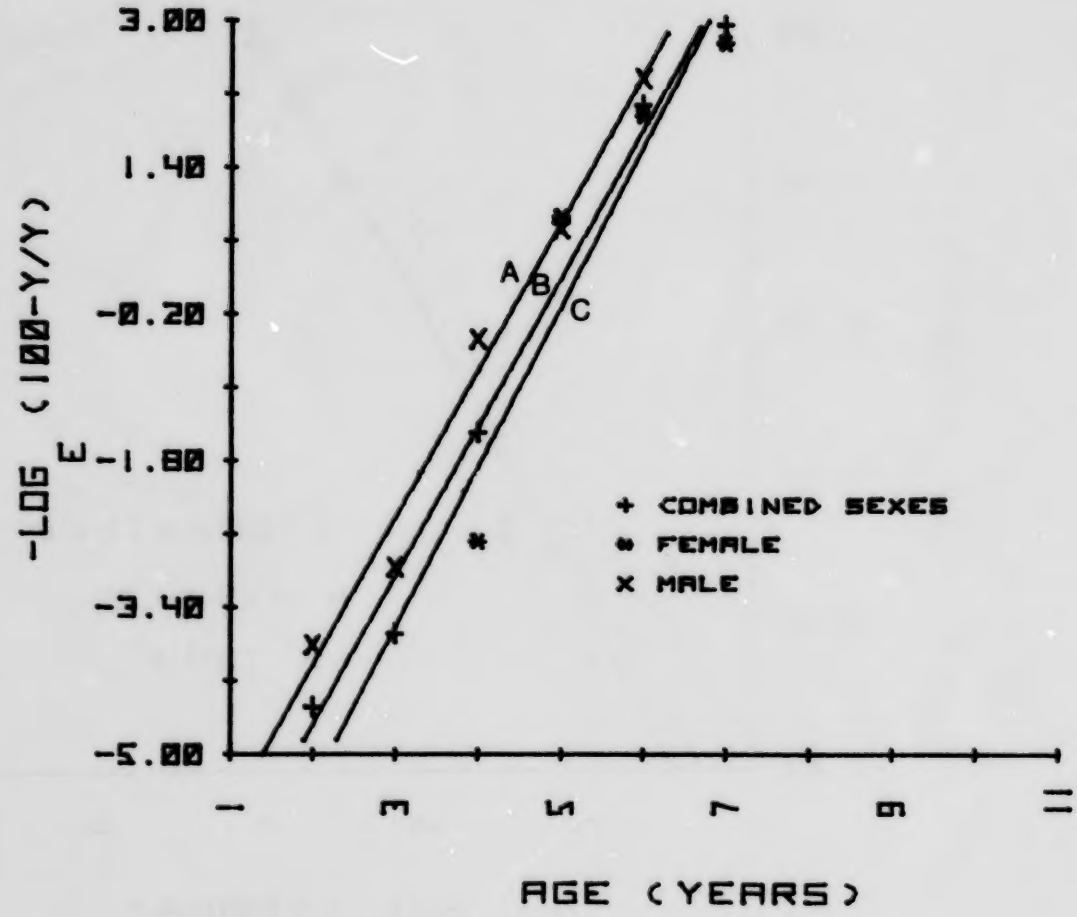

Fig. 3. Maturity curves of south basin saugers. Curve A - males, curve B - combined sexes, curve C - females.

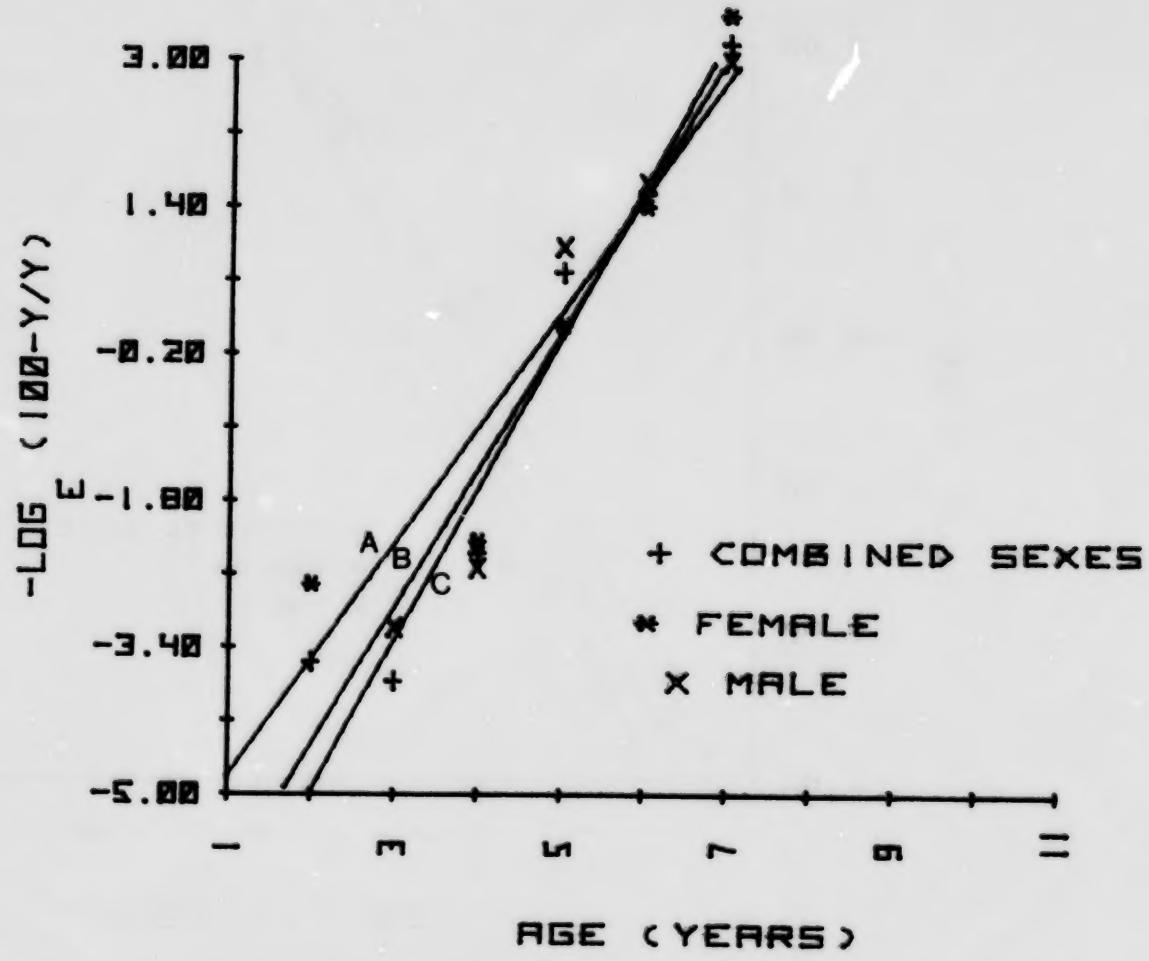

Fig. 4. Maturity curves of channel saugers. Curve A - females, curve B - combined sexes, curve C - males.

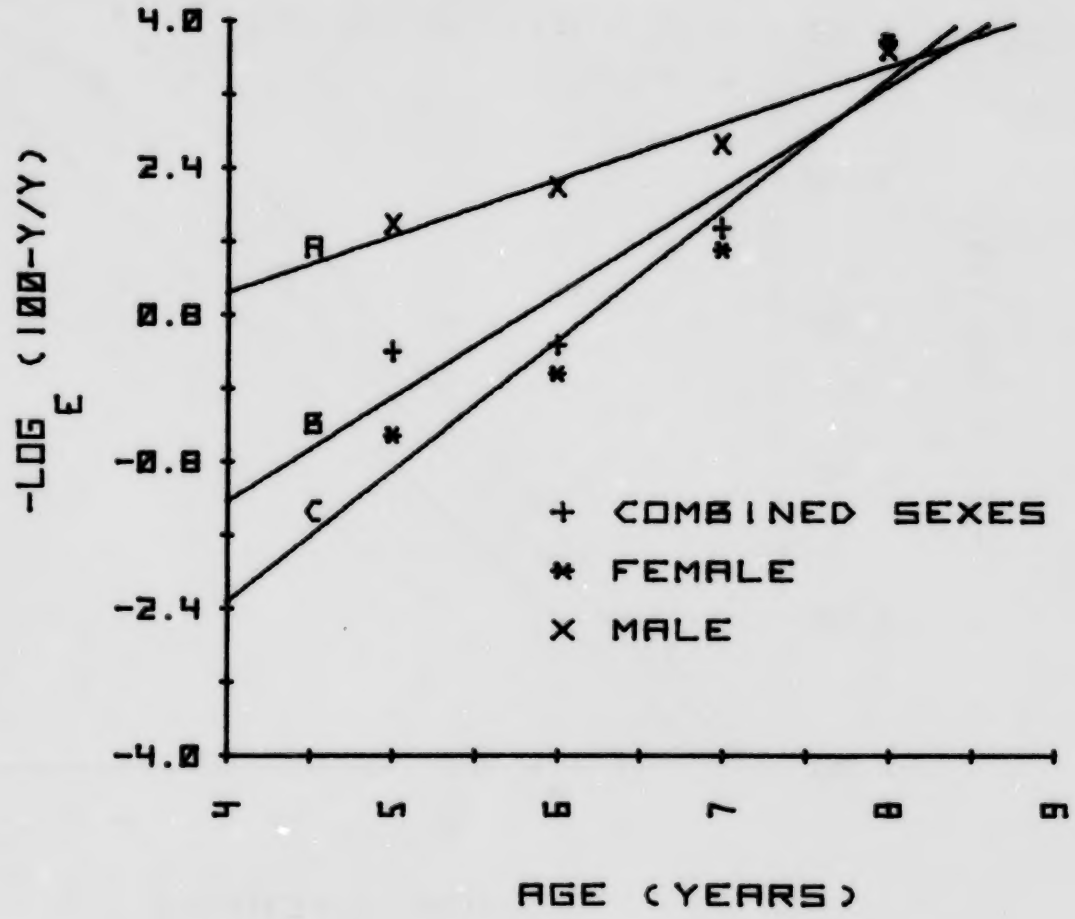

Fig. 5. Maturity curves of north basin saugers. Curve A - males, curve B - combined sexes, curve C - females.

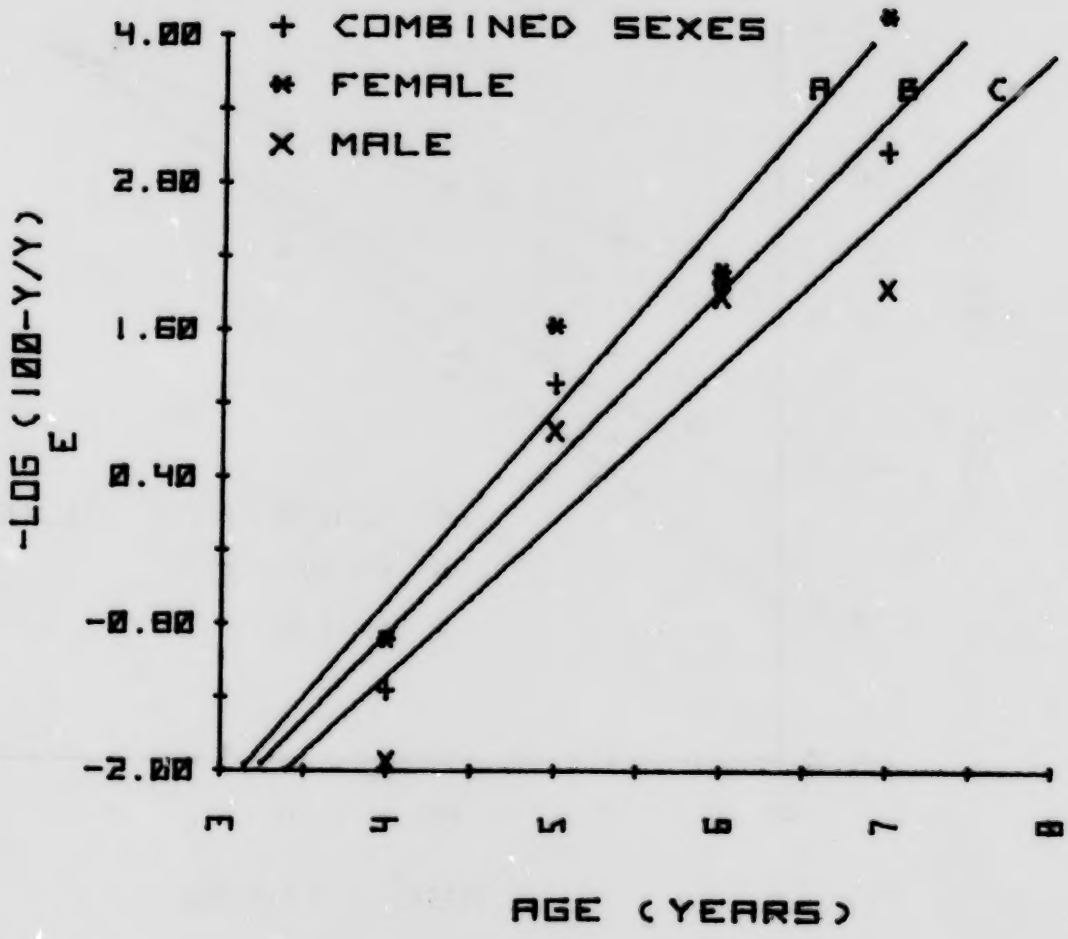

Fig. 6. Maturity curves of channel whitefish. Curve A - females, curve B - combined sexes, curve C - males.

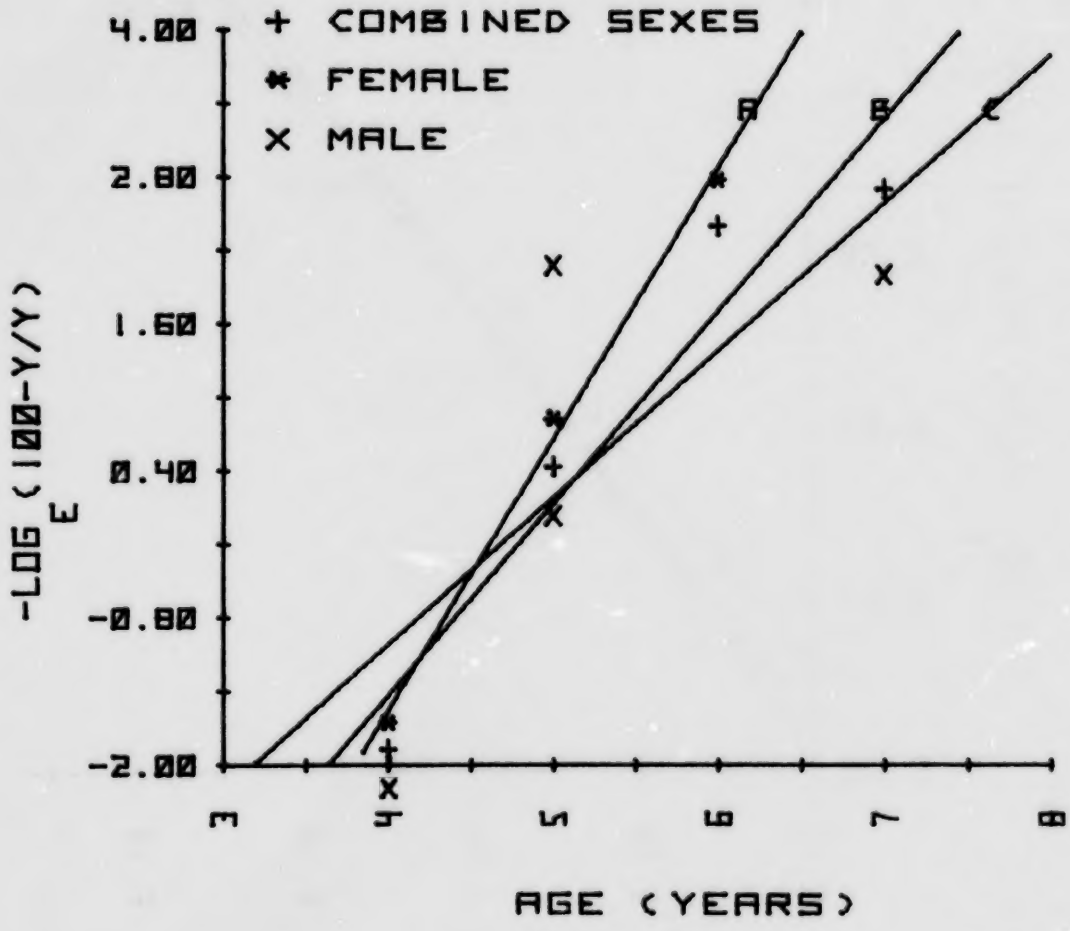

Fig. 7. Maturity curves of north basin whitefish. Curve A - females, curve B - combined sexes, curve C - males.

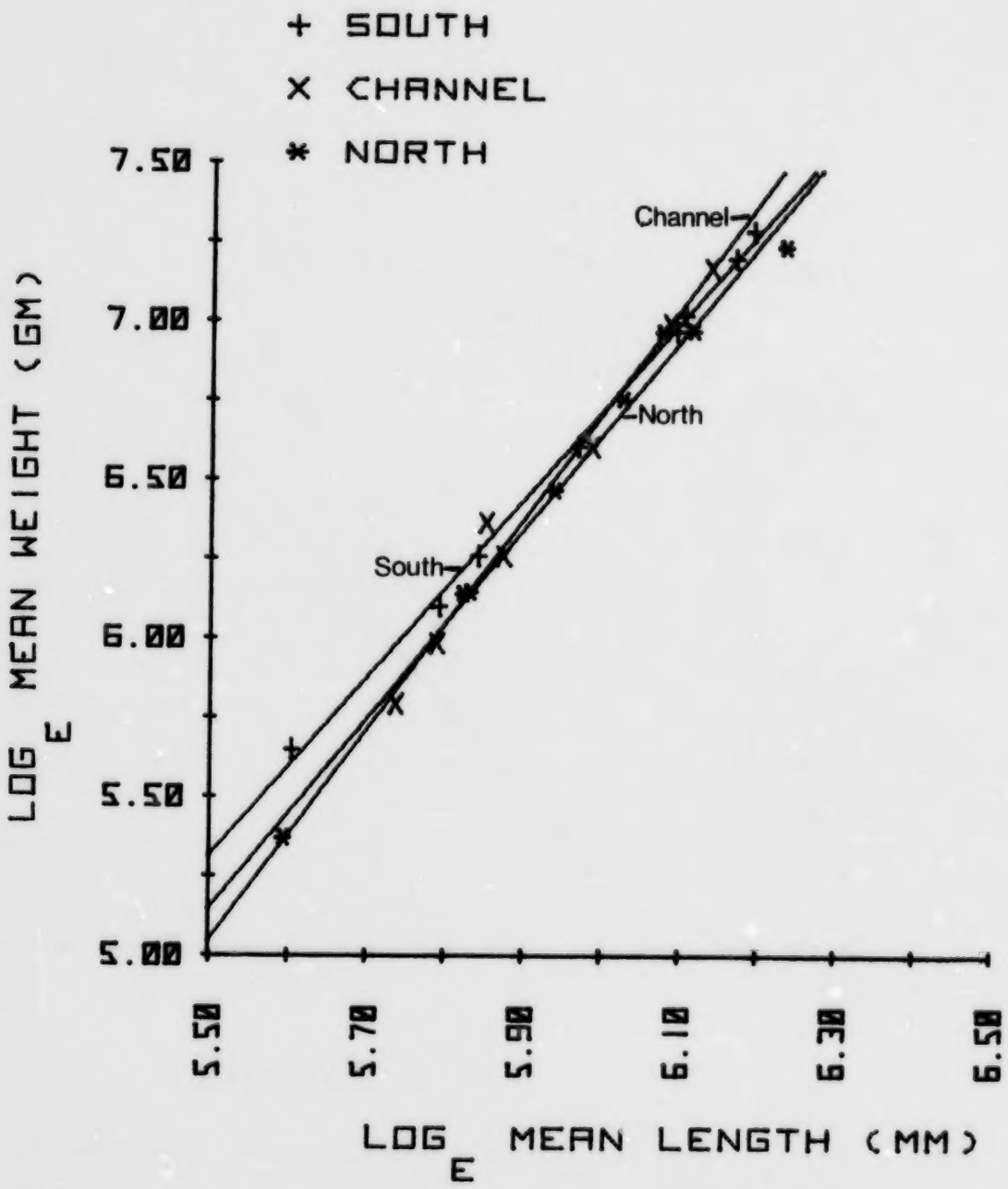

Fig. 8. Age-specific mean length-weight curves of walleyes.

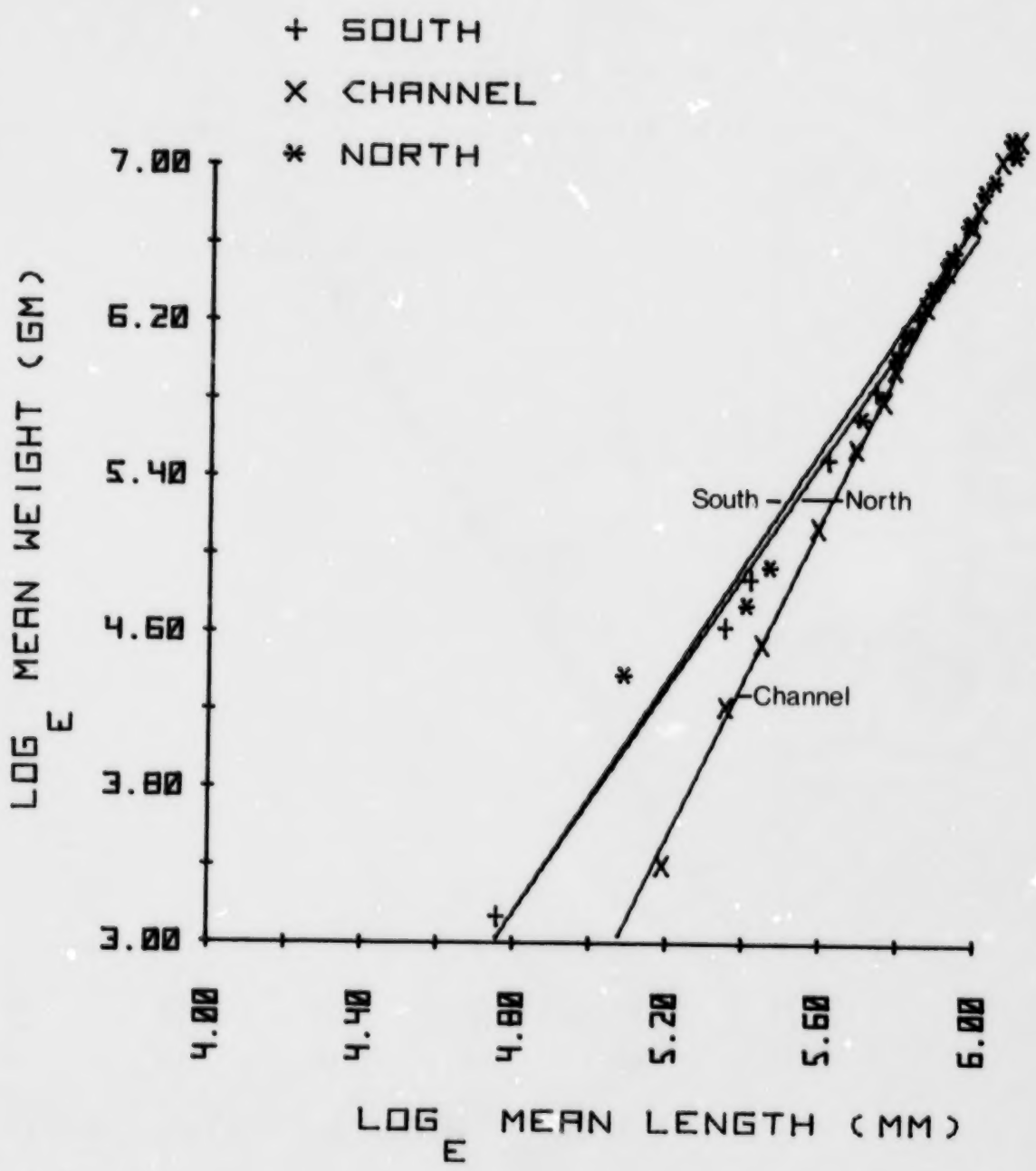

Fig. 9. Age-specific mean length-weight curves of saugers.

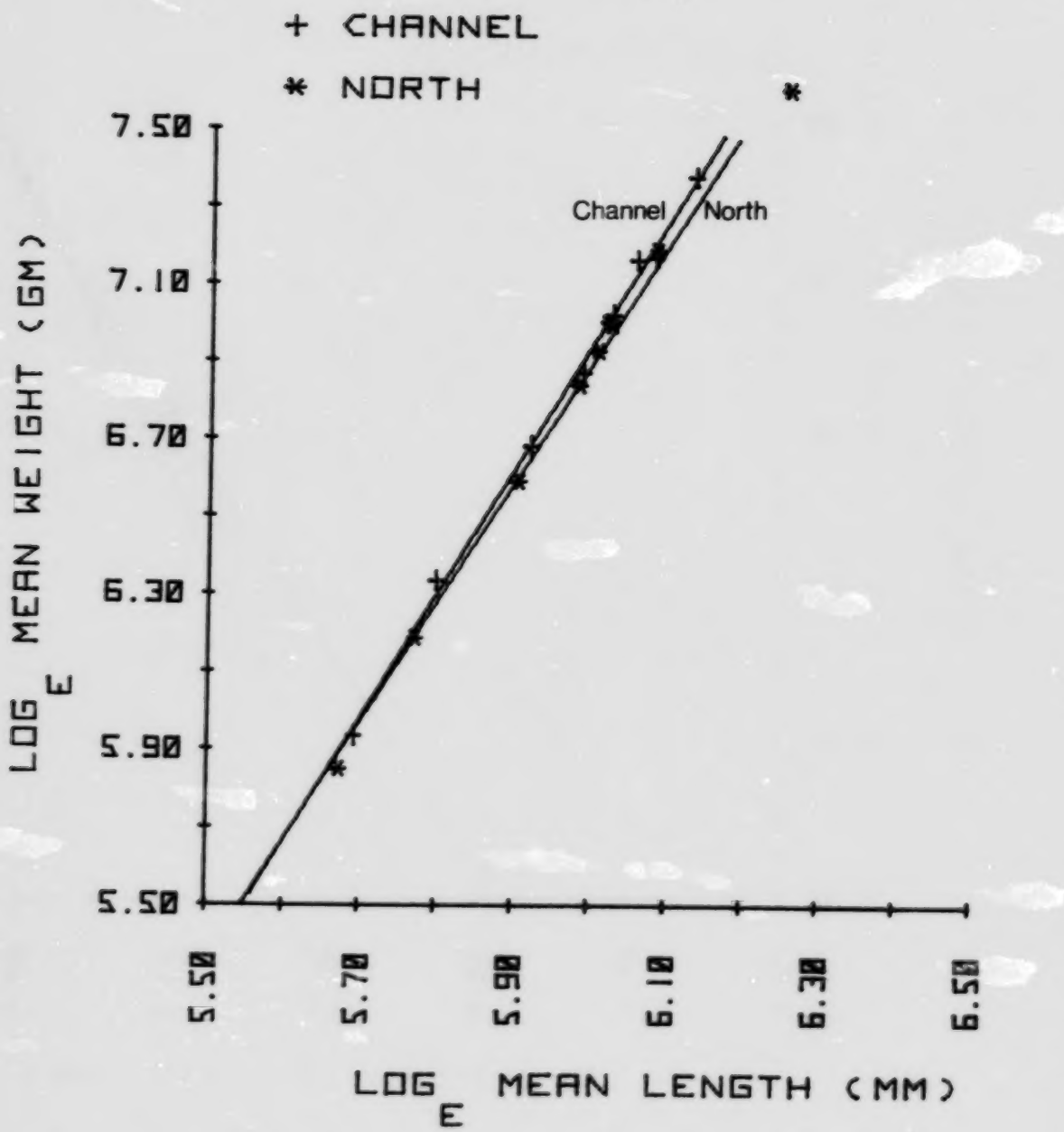

Fig. 10. Age-specific mean length-weight curves of whitefish.

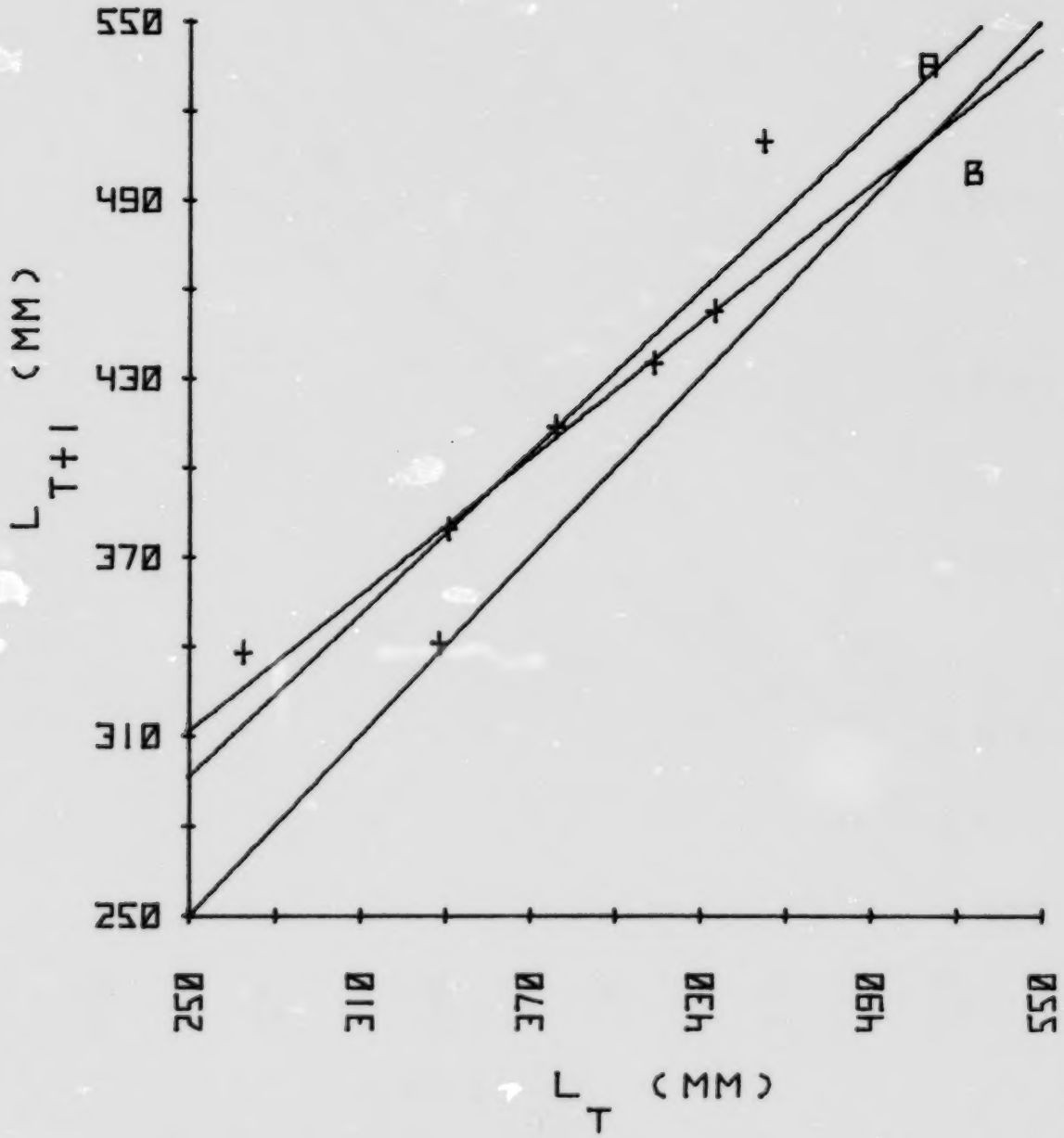

Fig. 11. Walford plots for northern walleyes. Curve A includes all points, curve B - lengths at ages 3 - 5 and 9 - 10 deleted.

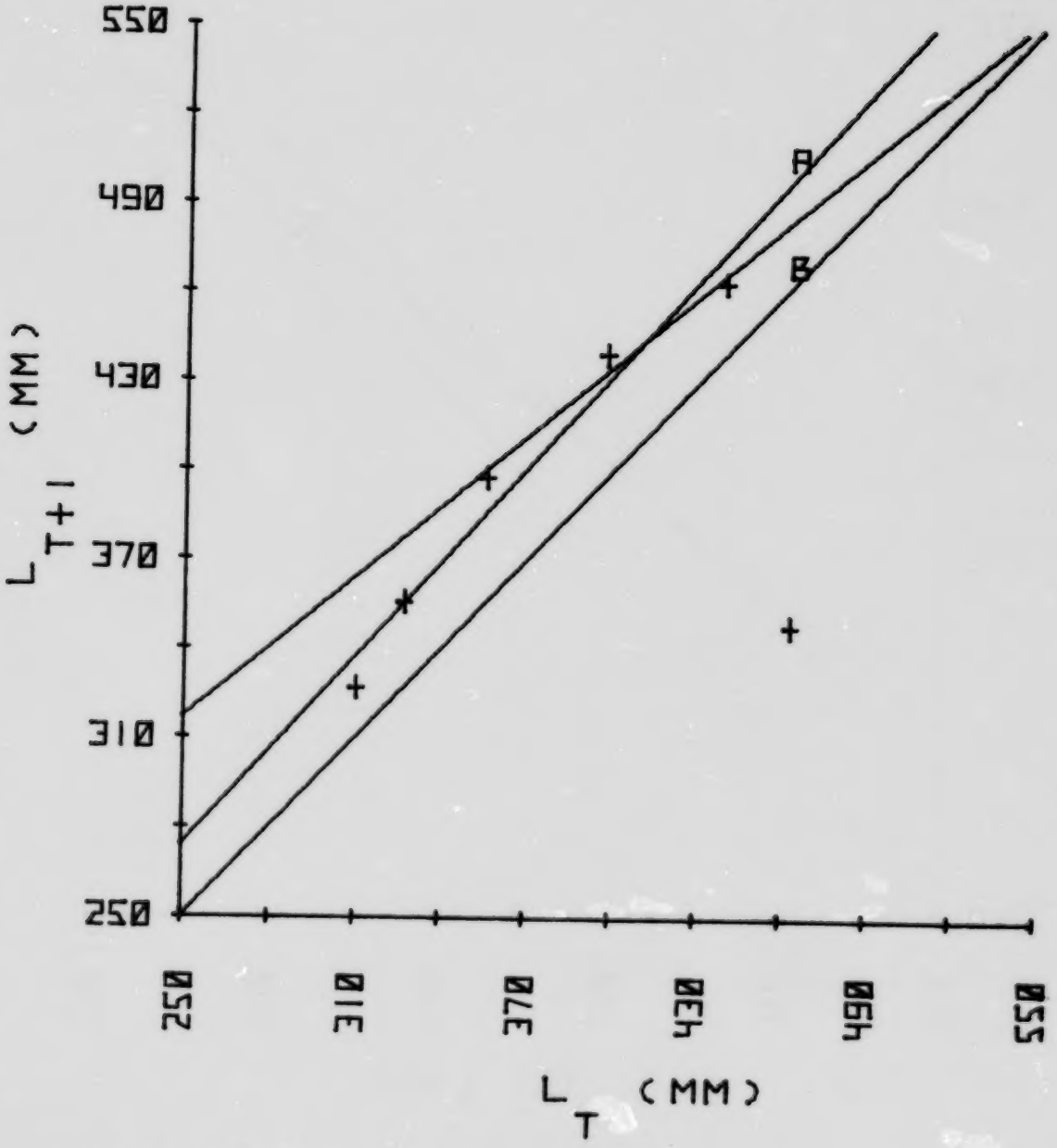

Fig. 12. Walford plots for channel walleyes. Curve A fitted to lengths at ages 3 - 8, curve B fitted to lengths at ages 5 - 8.

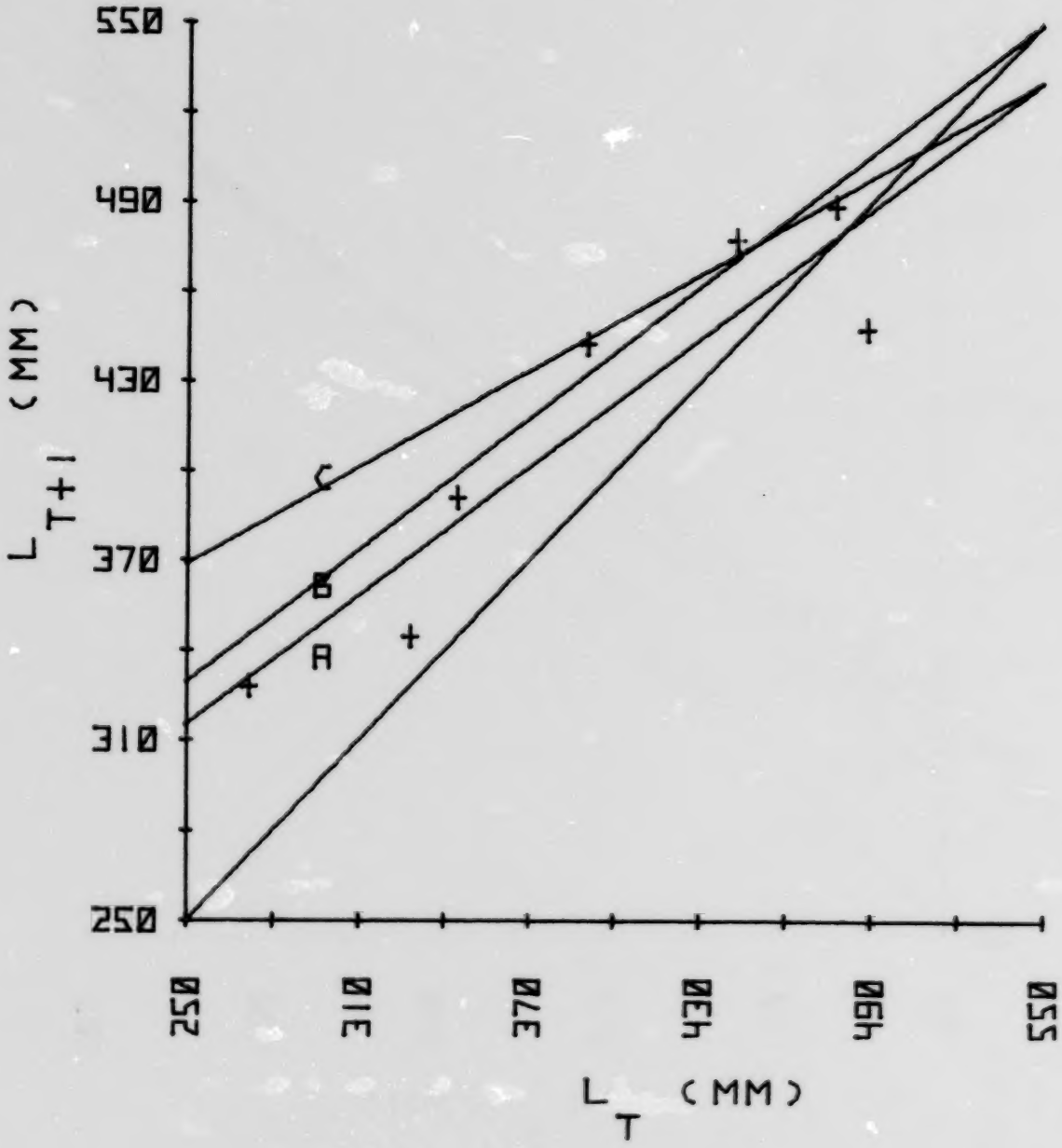

Fig. 13. Walford plots for southern walleyes. Curve A includes all points, curve B fitted to lengths at ages 4 - 8, curve C fitted to lengths at ages 5 - 8.

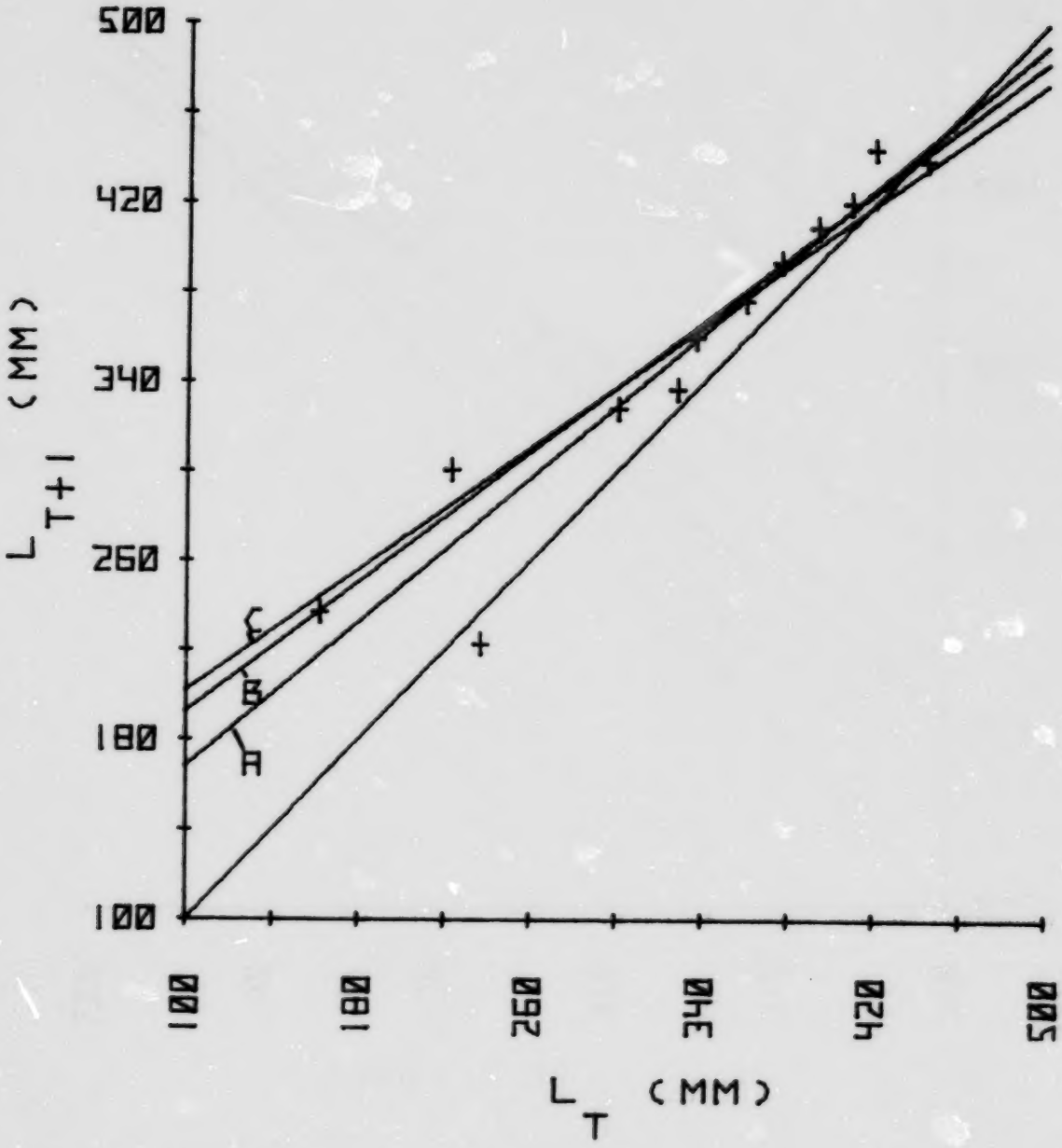

Fig. 14. Walford plots for northern saugers. Curve A includes all points, curve B fitted to lengths at ages 4 - 14, curve C fitted to lengths at ages 4 - 12.

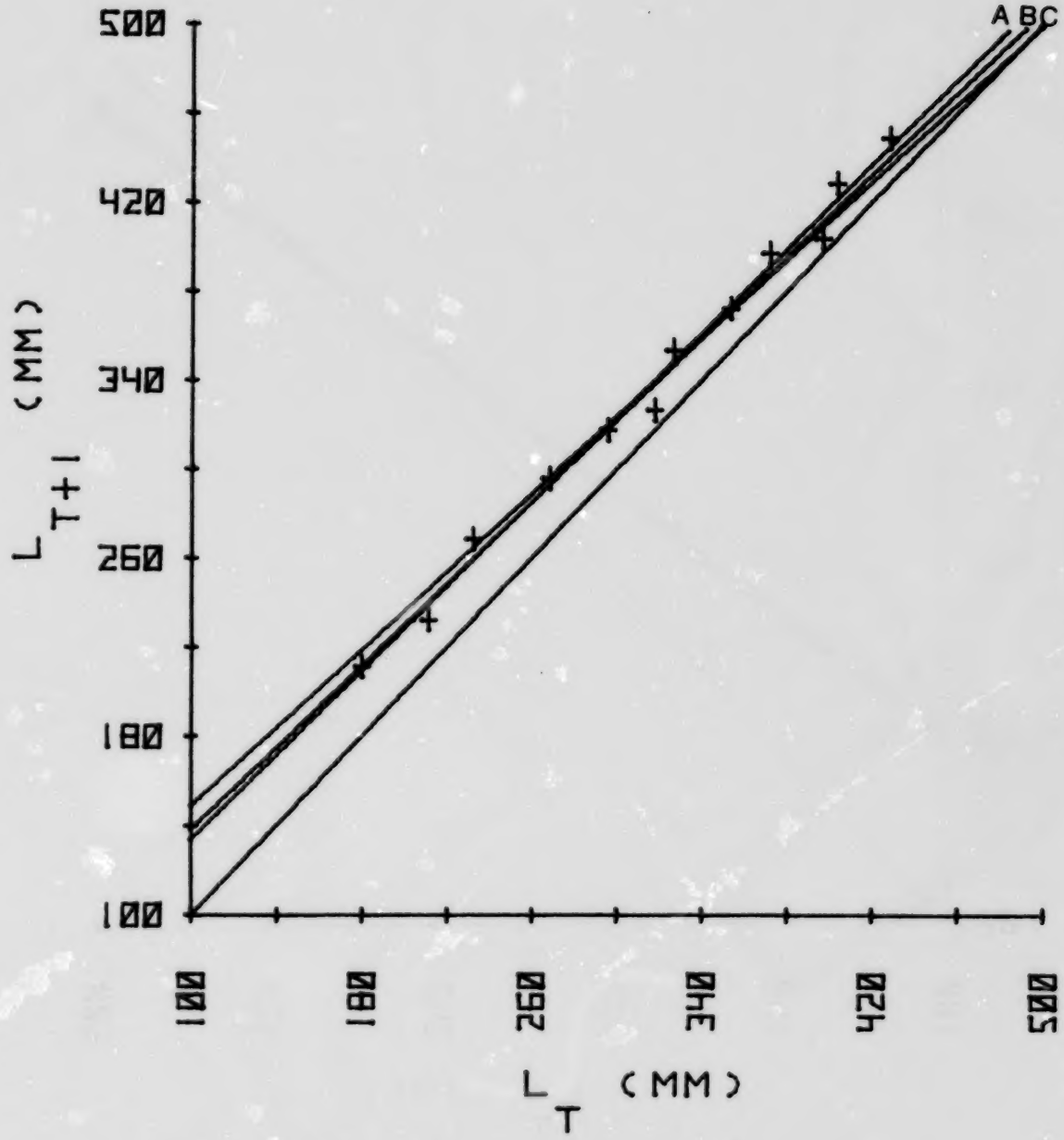

Fig. 15. Walford plots for channel saugers. Curve A includes all points. Curve B fitted to lengths at ages 2 - 11, curve C fitted to lengths at ages 3 - 11.

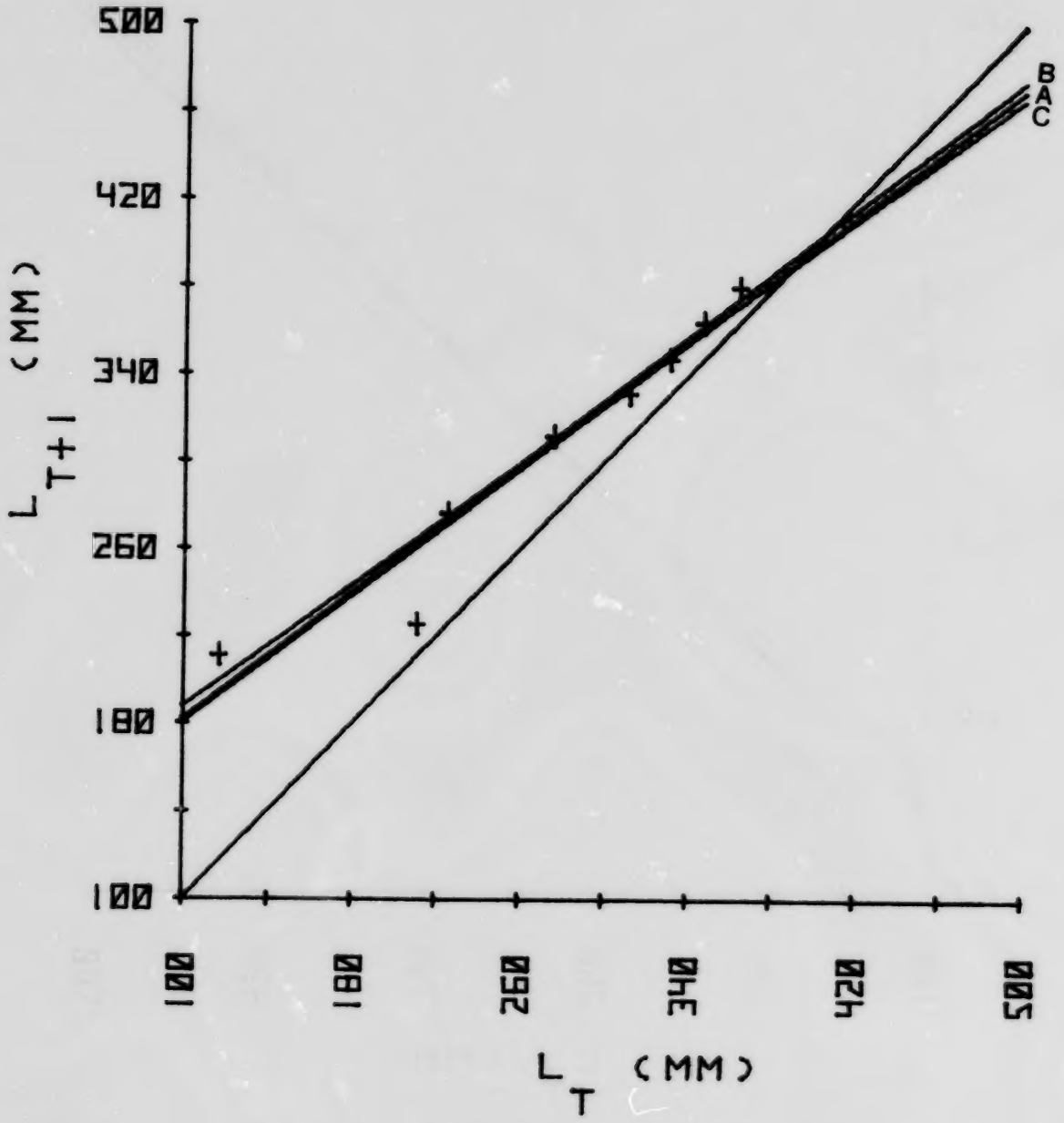

Fig. 16. Walford plots for southern saugers. Curve A includes all points, curve B fitted to lengths at ages 3 - 9, curve C fitted to lengths at ages 3 - 8.

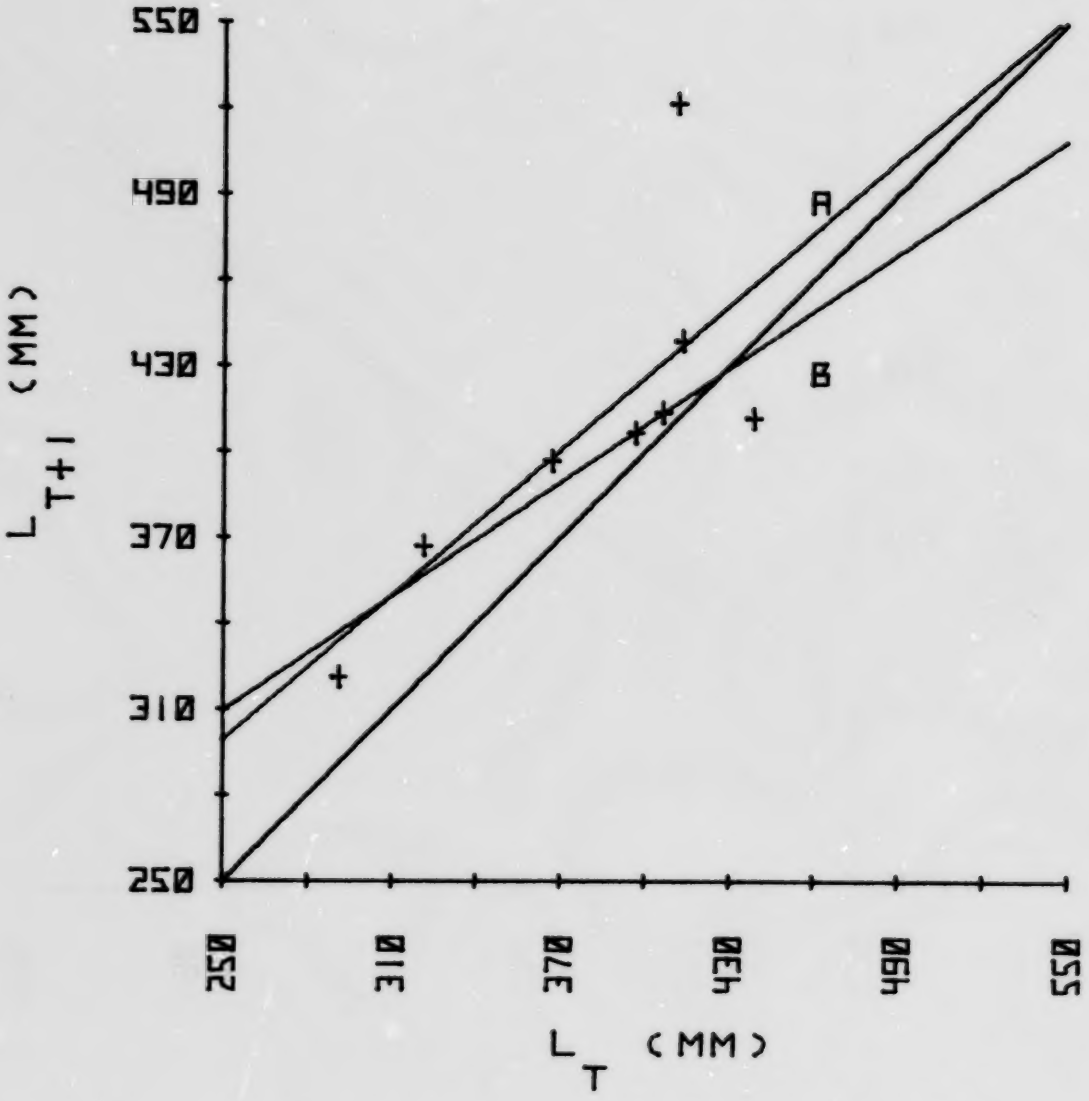

Fig. 17. Walford plots for north basin whitefish. Curve A - all points, curve B - length at age 10 versus length at age 11 deleted.

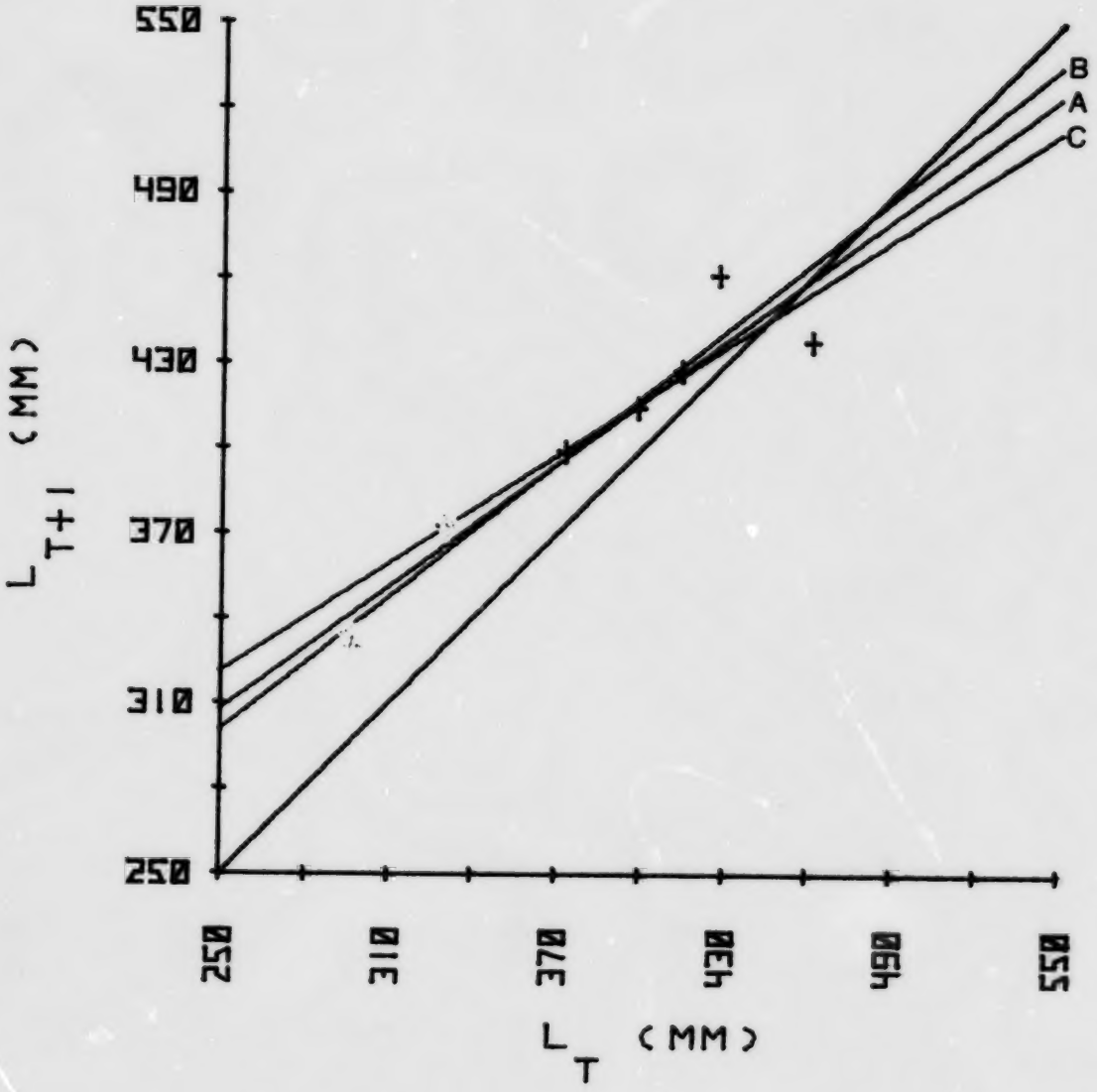

Fig. 18. Walford plots for channel whitefish. Curve A includes all points, curve B - ages 8 - 10 deleted, curve C - ages 3 - 4, 8 - 10 deleted.

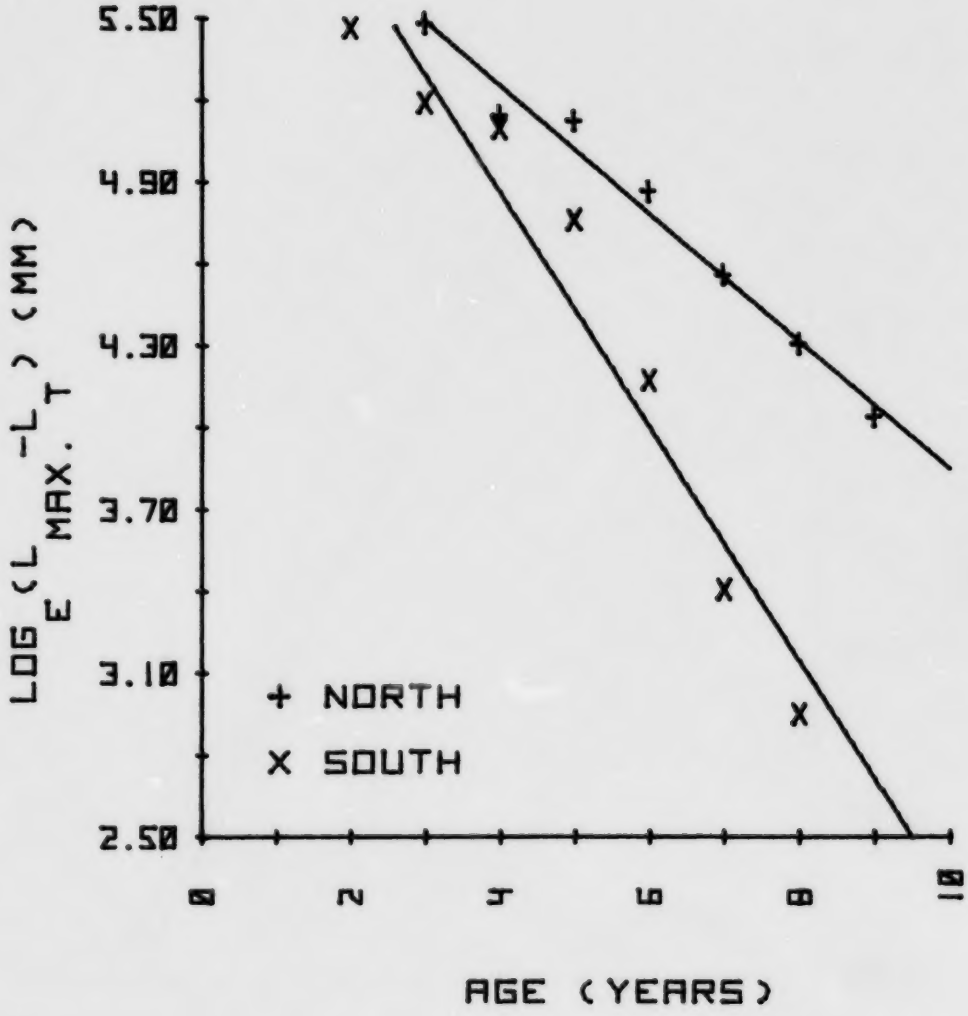

Fig. 19. Plots of $(L_\infty - l_t)$ versus age for northern and southern basin walleyes. The aberrent data point at age 9 was deleted from the southern walleye curve.

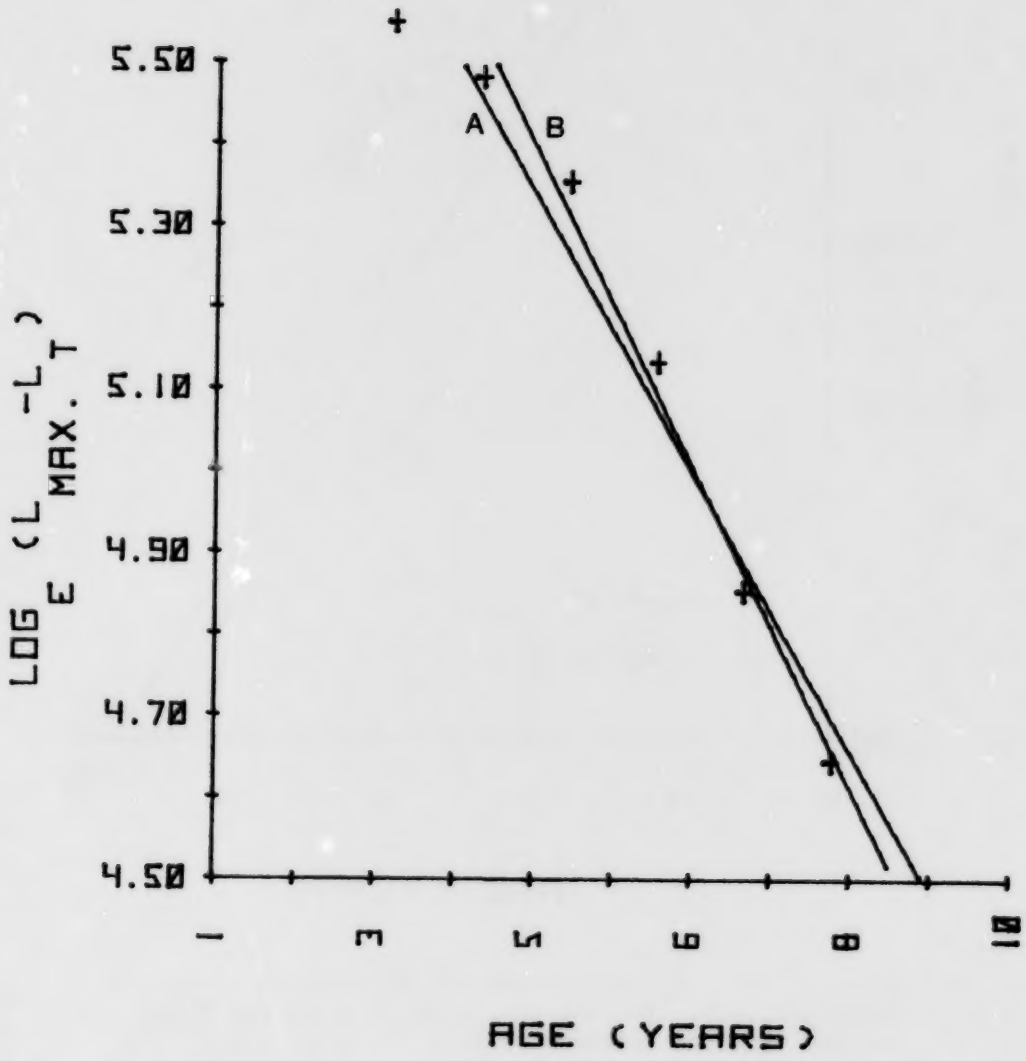

Fig. 20. Plots of $\log_e (L_\infty - l_t)$ versus age for channel walleyes. Curve A includes all points, point at age 3 was deleted to yield curve B.

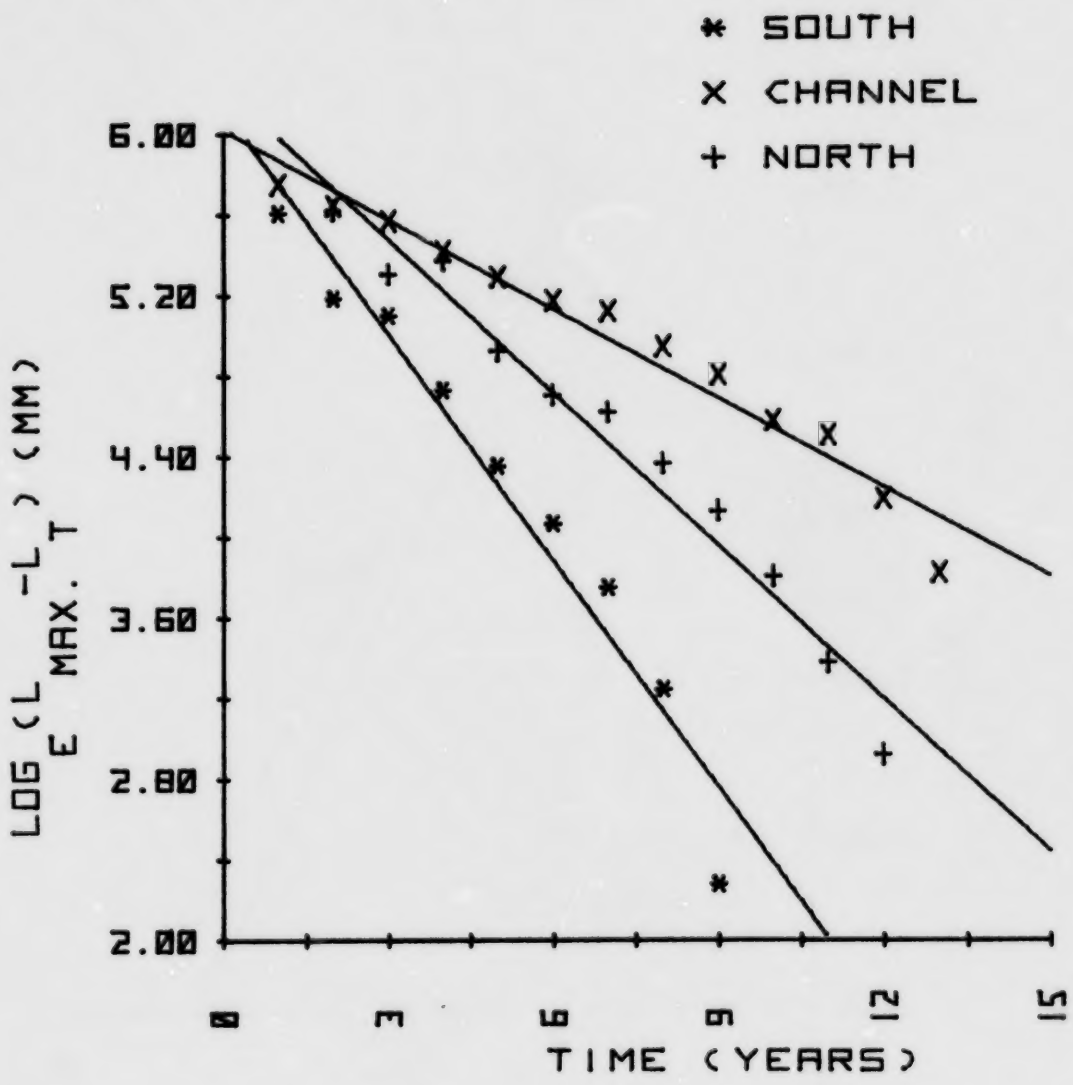

Fig. 21. Plot of $\log_e (L_\infty - l_t)$ versus t for Lake Winnipeg saugers.

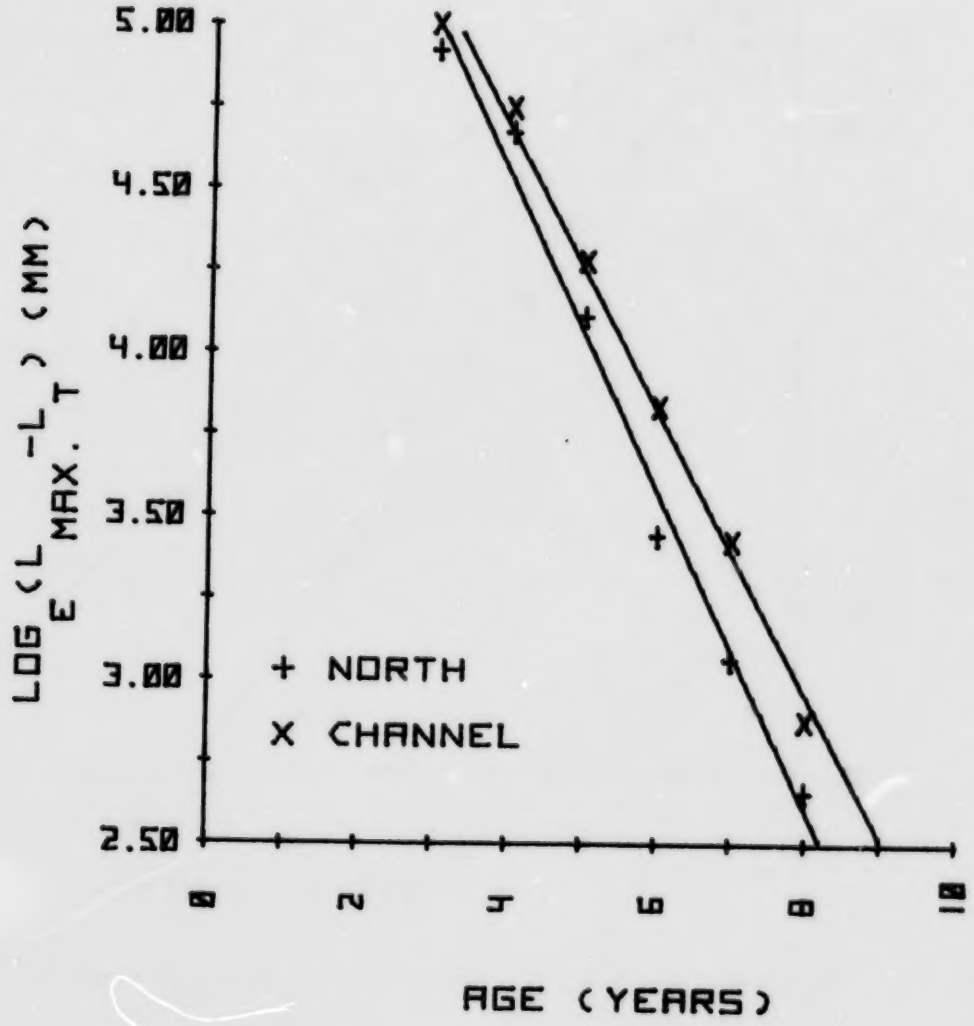

Fig. 22. Plots of $\log_e (L_\infty - l_t)$ versus age for channel and northern basin whitefish populations. Lengths at ages 9+ were deleted from both curves since these age classes each contained <5 fish.

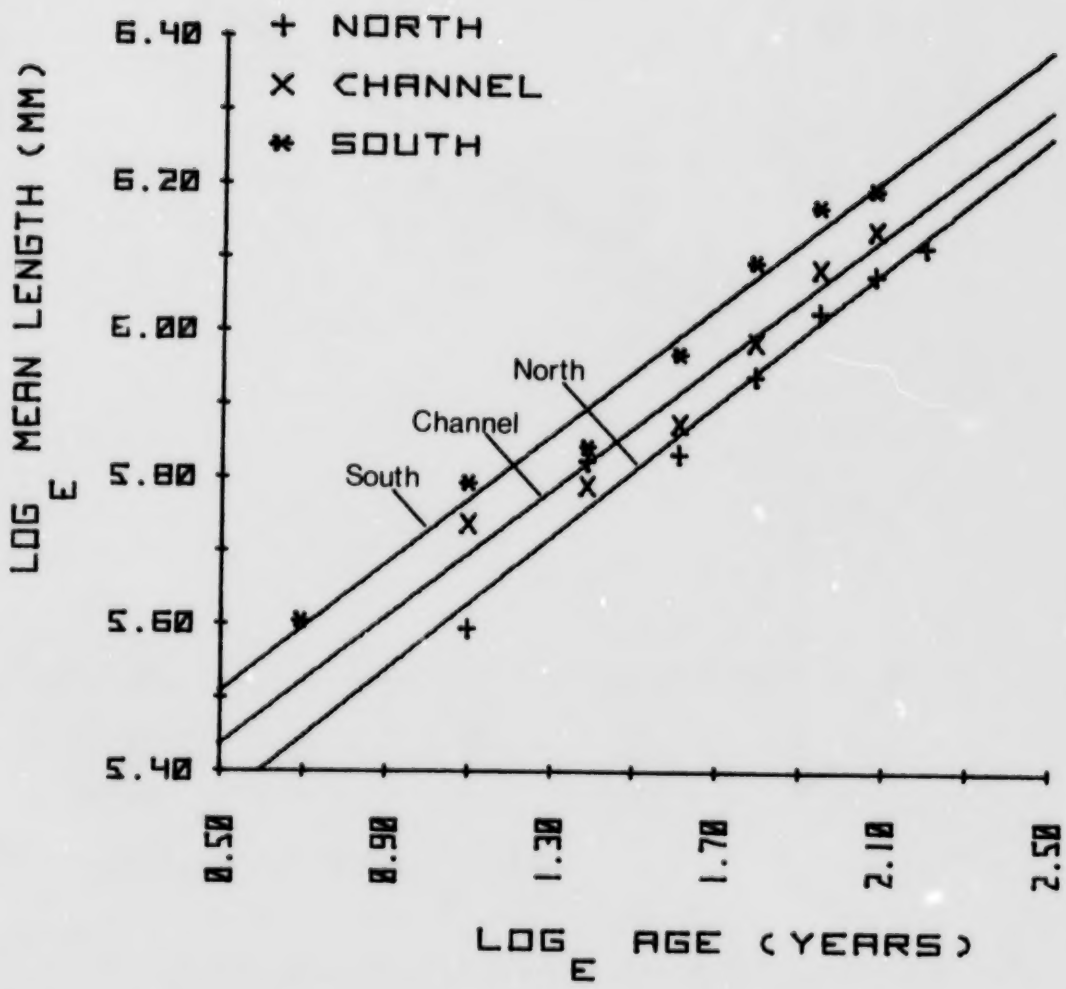

Fig. 23. Exponential growth curves of walleyes from the three major areas of Lake Winnipeg, 1982.

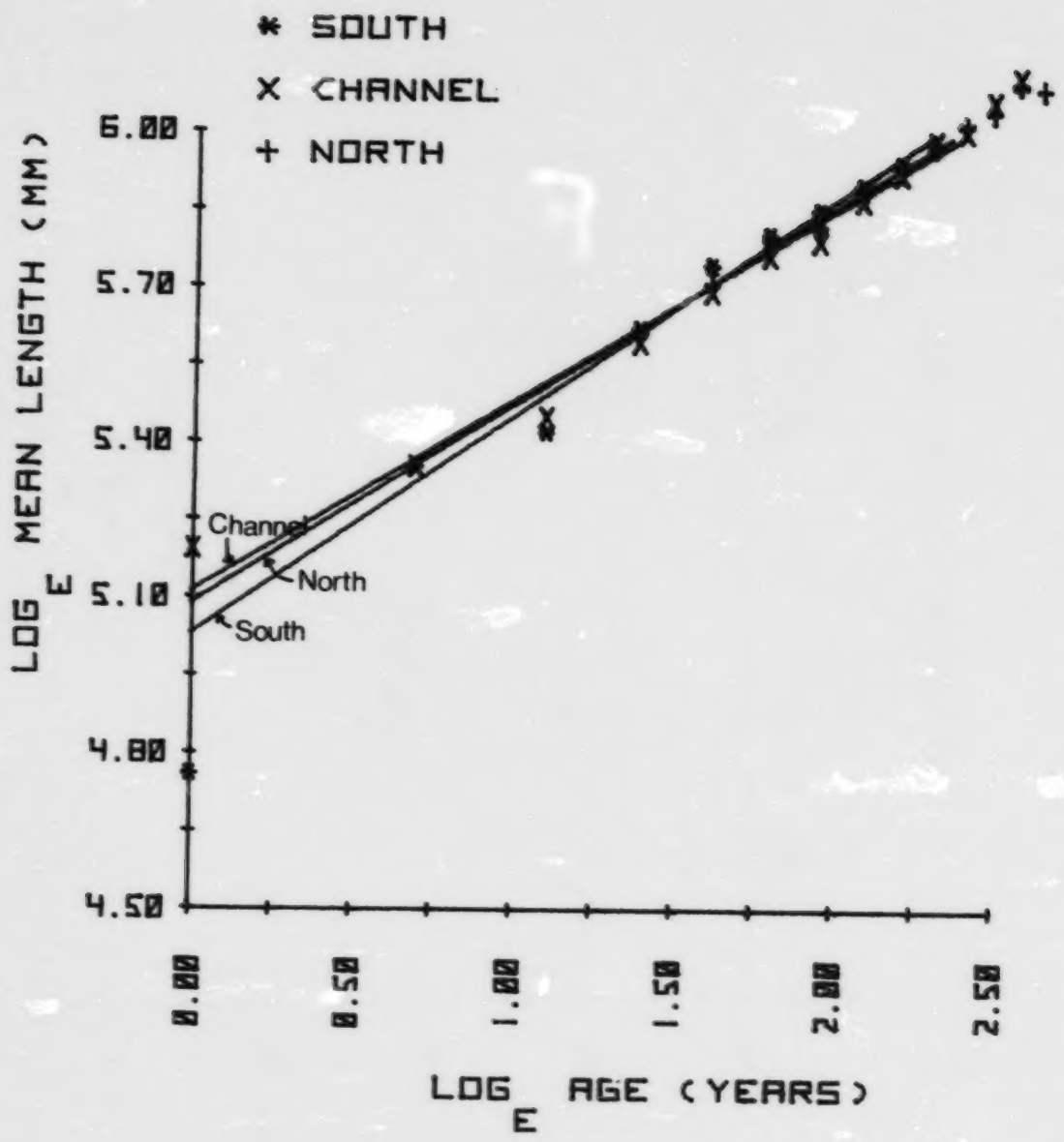

Fig. 24. Exponential growth curves of Lake Winnipeg saugers.

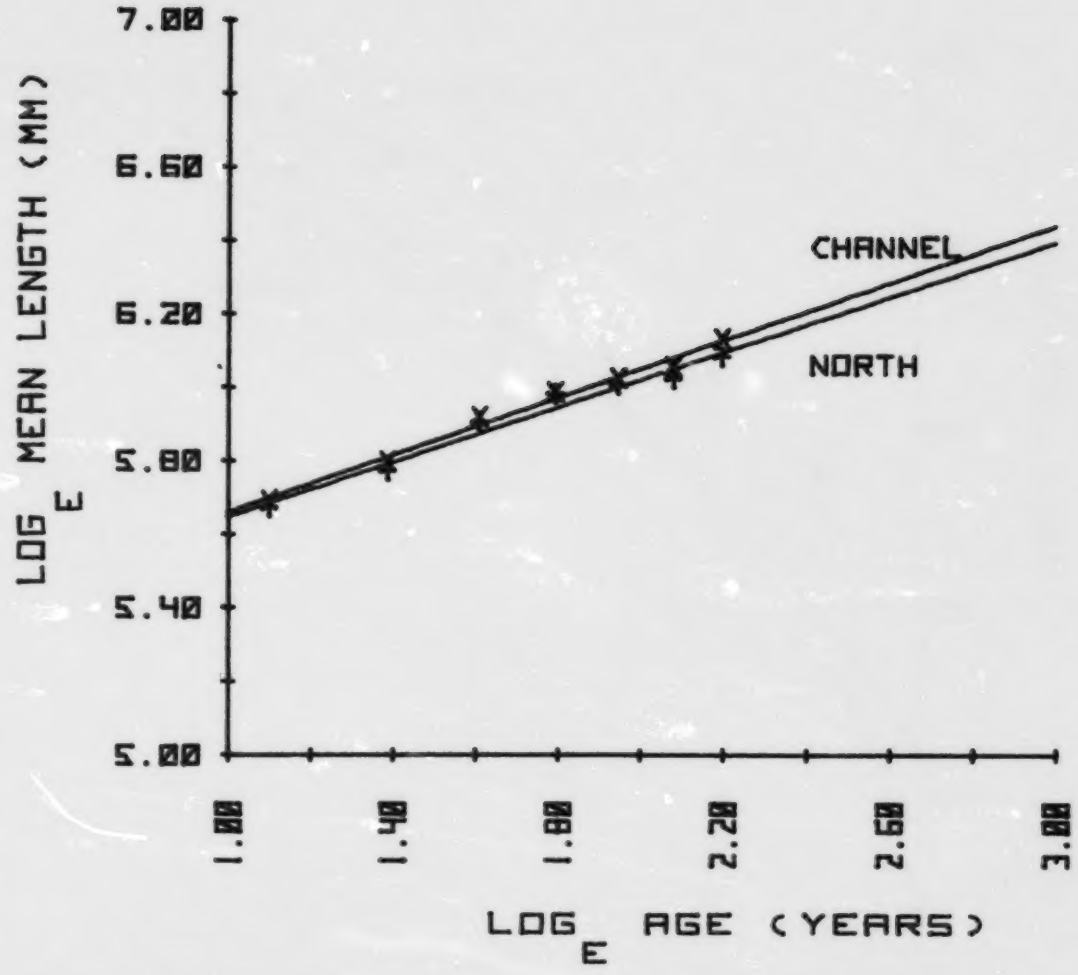

Fig. 25. Exponential growth curves of channel and north basin whitefish. Age classes containing <5 fish were deleted from analyses.

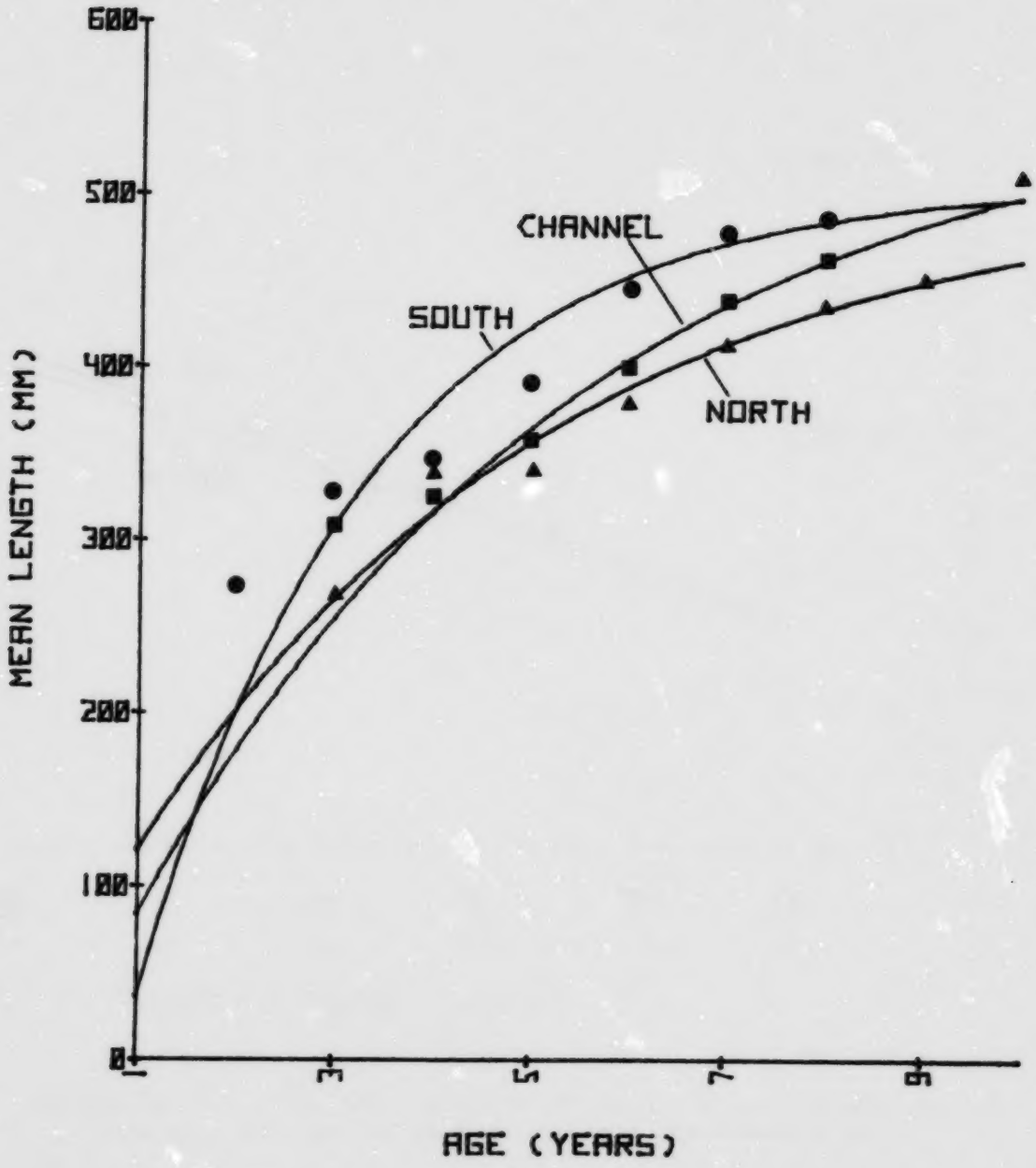

Fig. 26. Von Bertalanffy growth curves of walleyes from the south basin, channel and north basin of Lake Winnipeg, 1982.

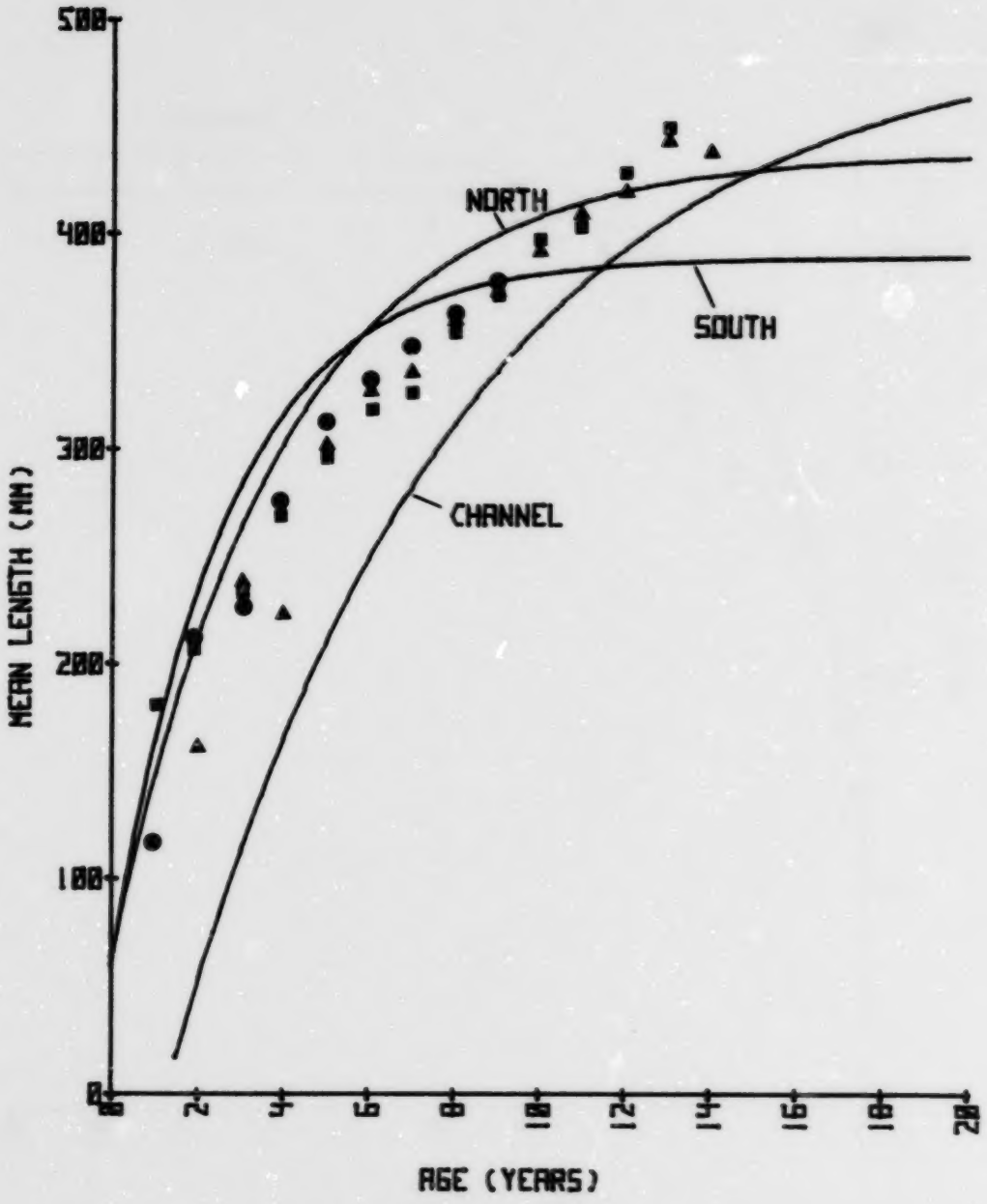

Fig. 27. Von Bertalanffy growth curves of saugers from the three major areas of Lake Winnipeg, 1982.

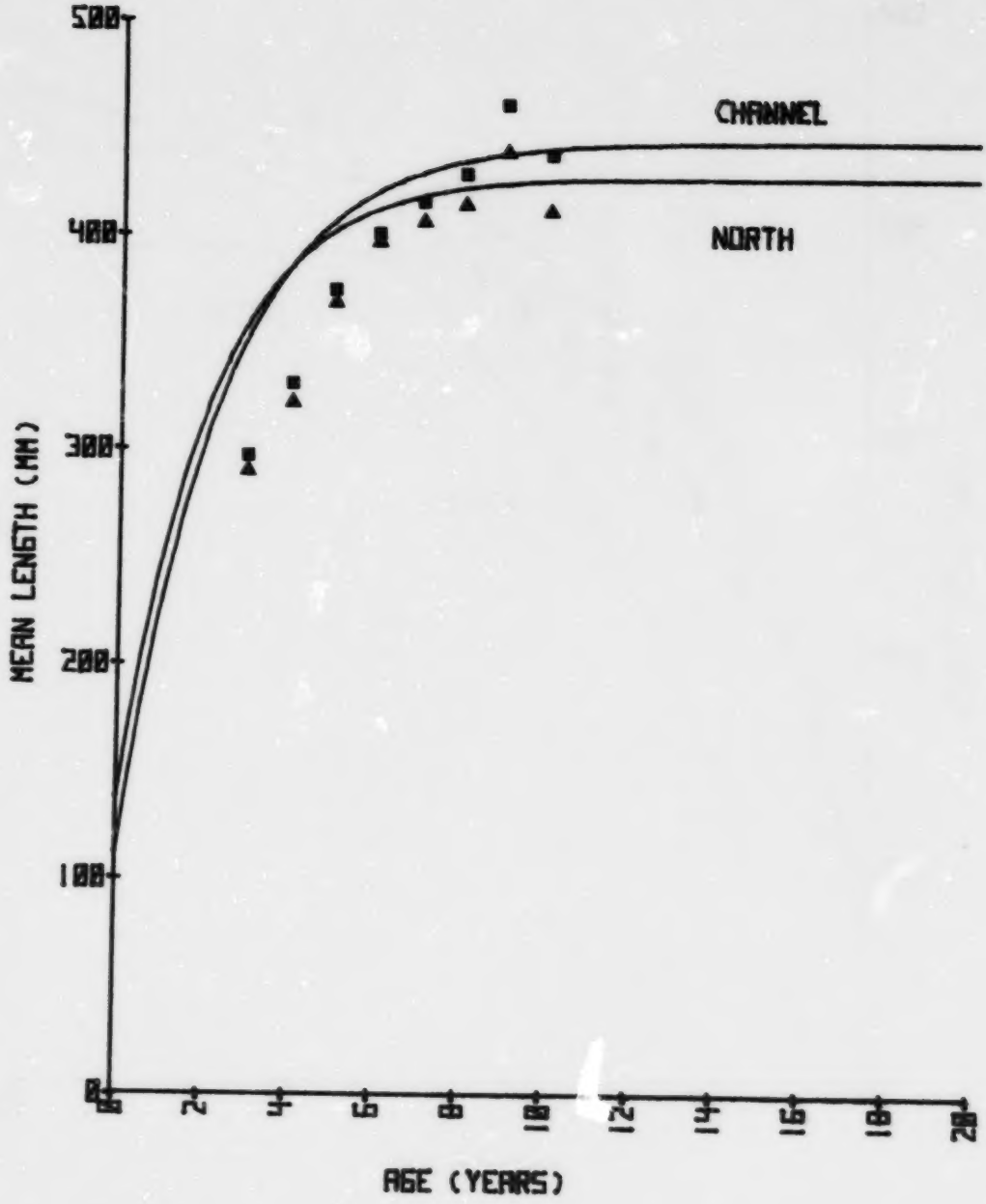

Fig. 28. Von Bertalanffy growth curves of whitefish from the channel and north basin of Lake Winnipeg, 1982.

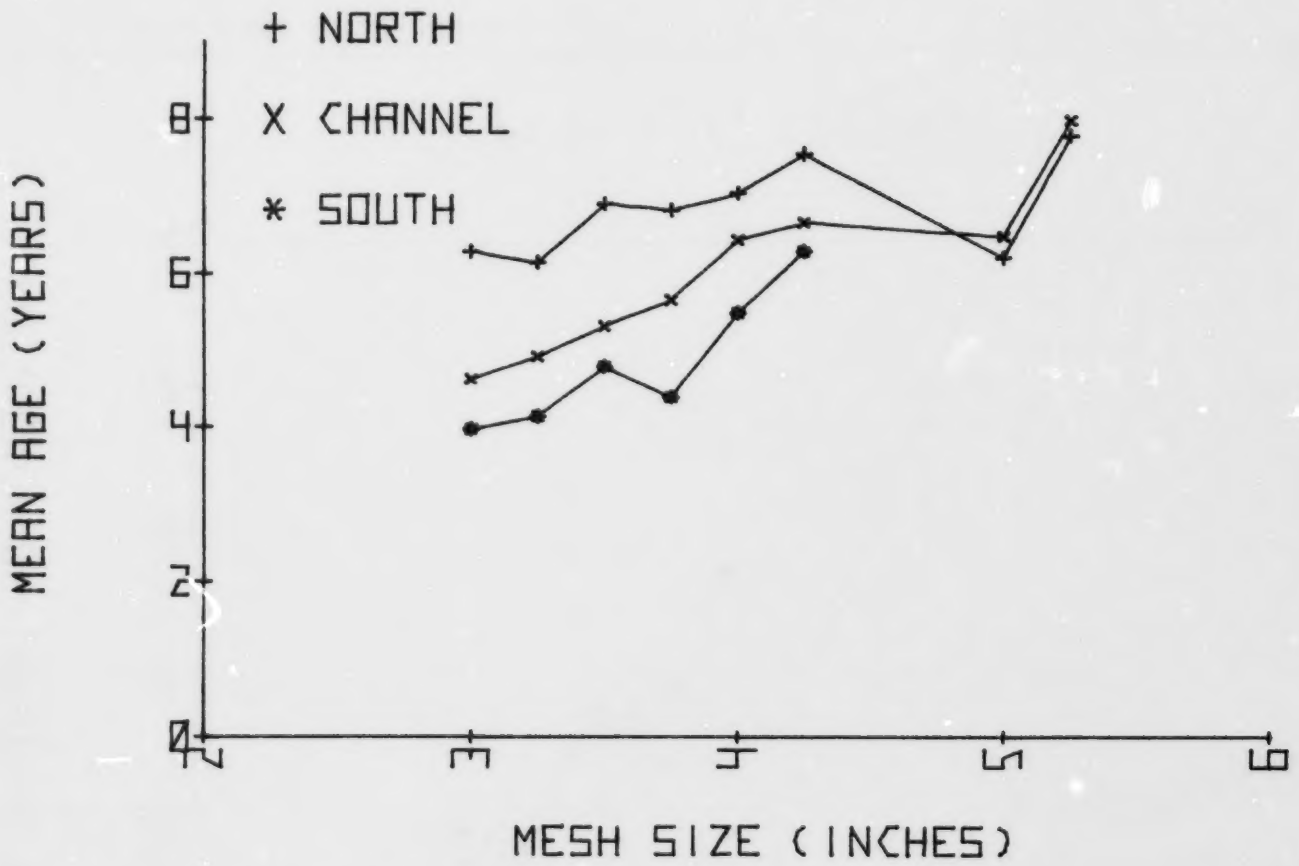

Fig. 29. The relationship of mean ages of walleyes and mesh sizes in the three major areas of Lake Winnipeg, 1982.

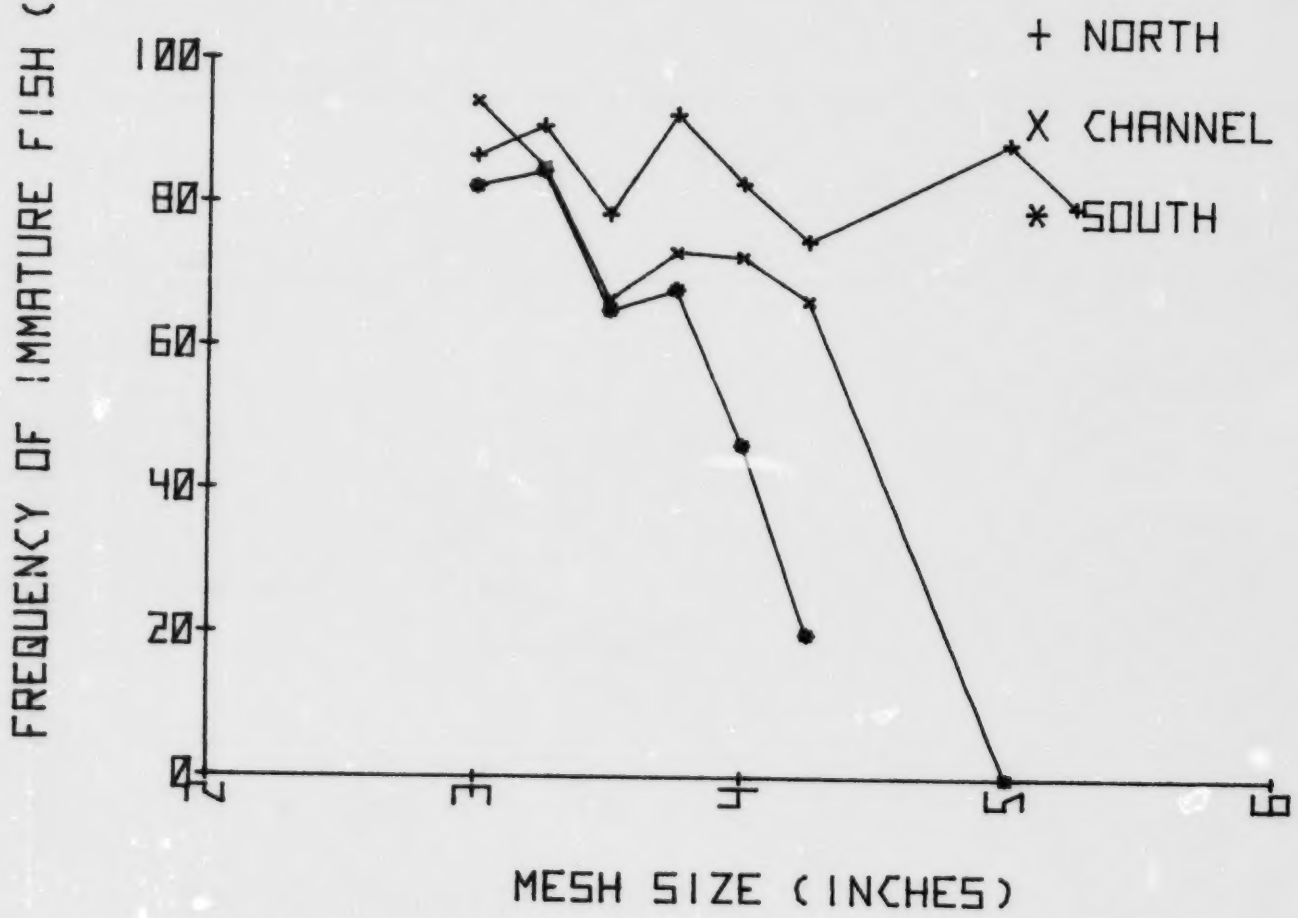

Fig. 30. Changes in frequencies of immature walleyes in relation to mesh size in the three major areas of Lake Winnipeg, 1982.

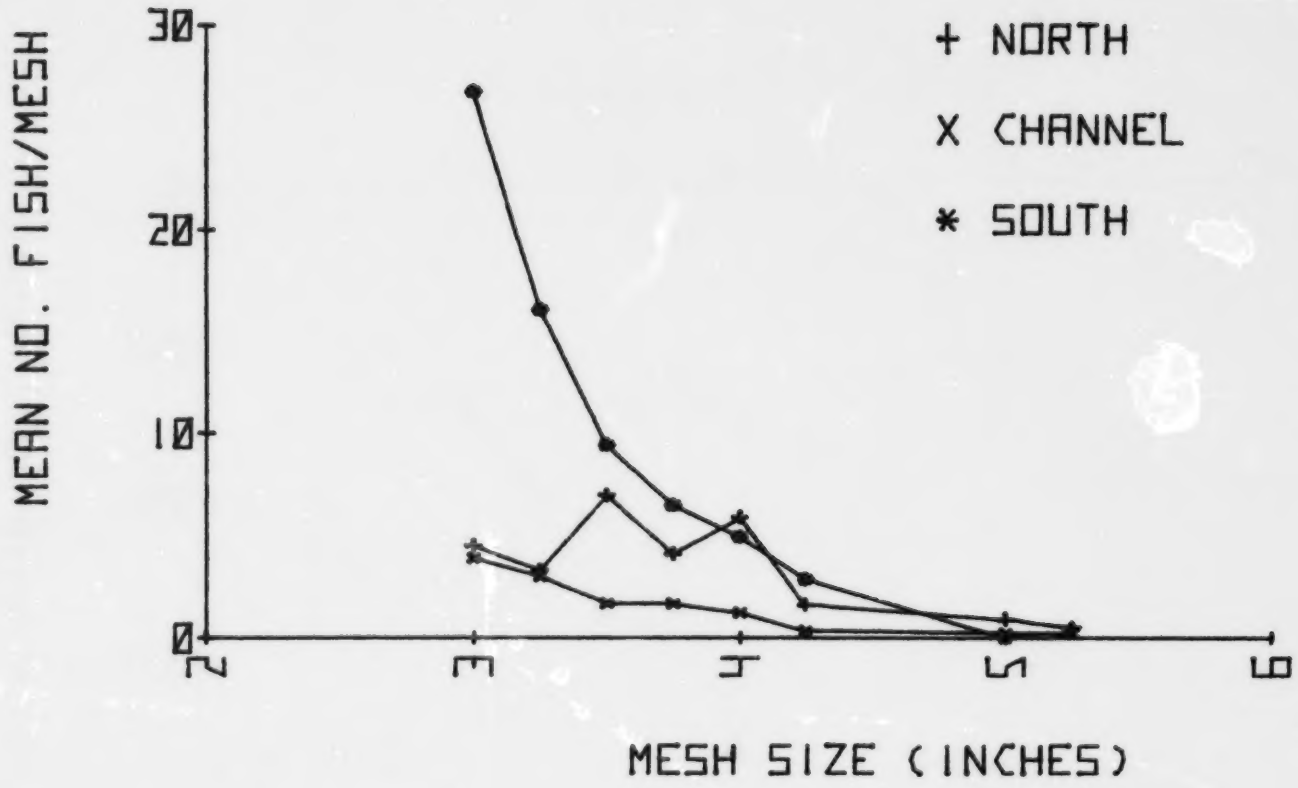

Fig. 31. Effects of mesh size on the mean numbers of walleyes caught per net in the three major areas of Lake Winnipeg, 1982.

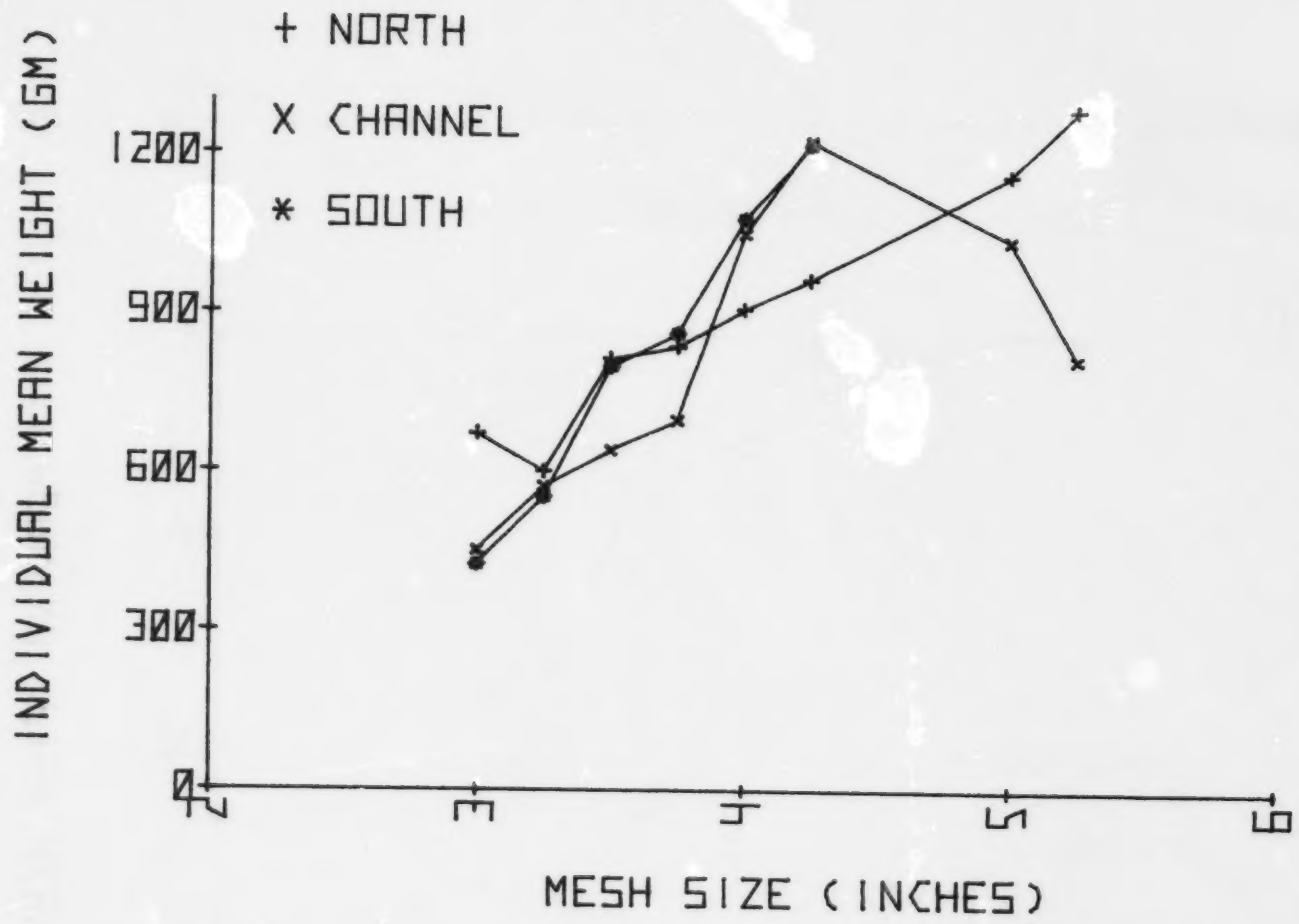

Fig. 32. Effects of mesh size on mean weights of saugers caught in the three major areas of Lake Winnipeg, 1982.

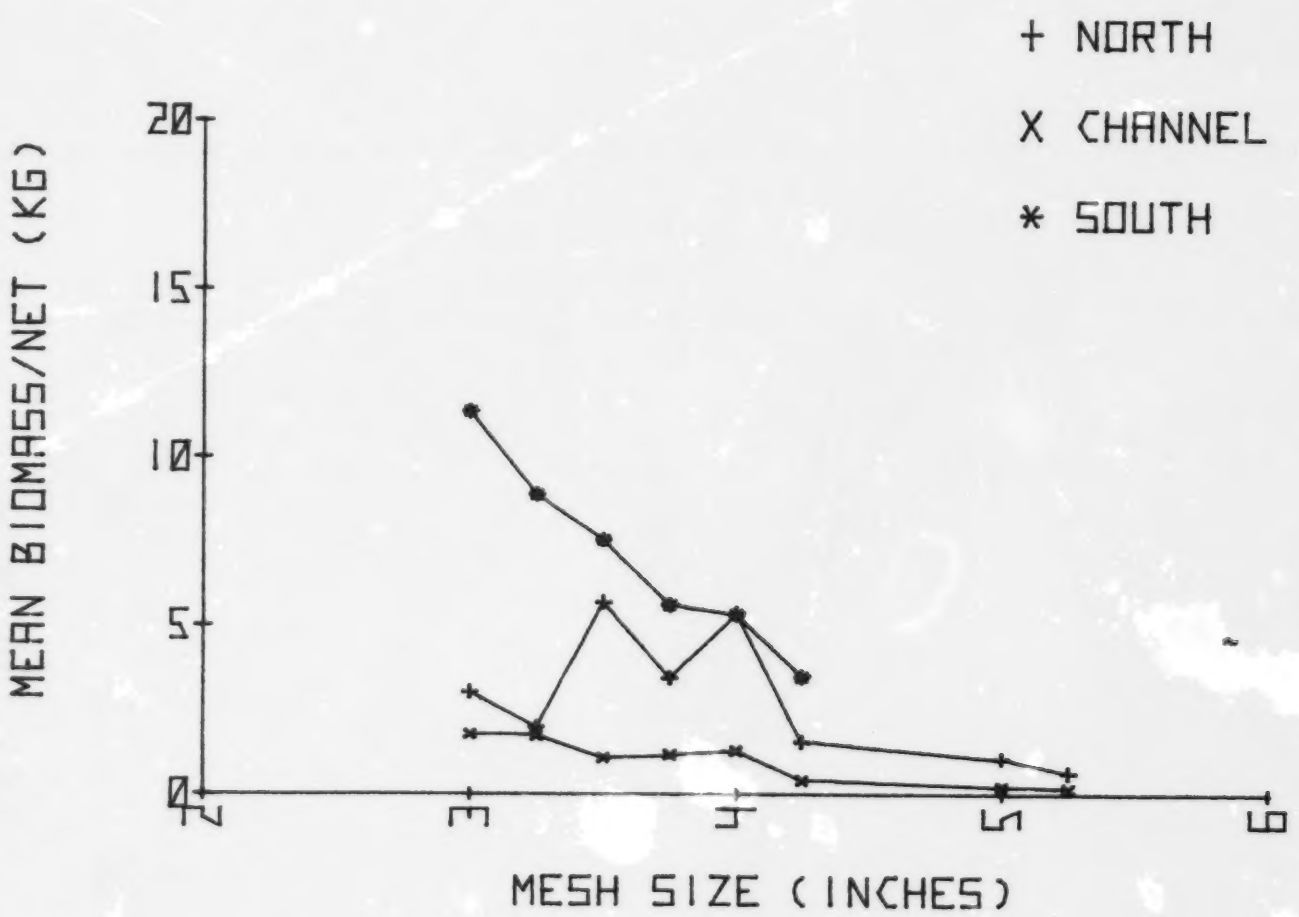

Fig. 33. Effects of mesh size on the mean biomass per net of walleyes caught in the three major areas of Lake Winnipeg, 1982.

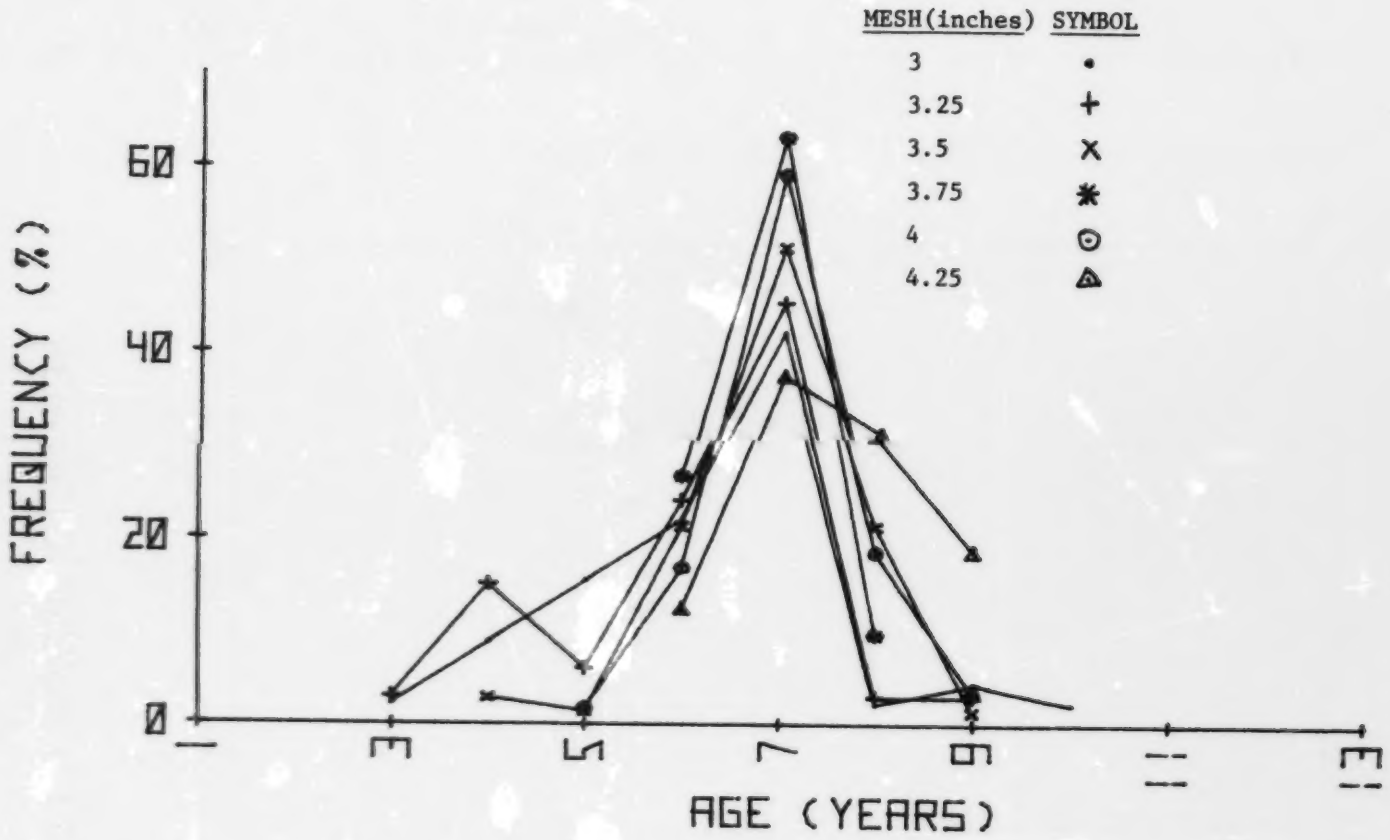

Fig. 34. Effects of mesh size on age frequency distributions of north basin walleyes, 1982.

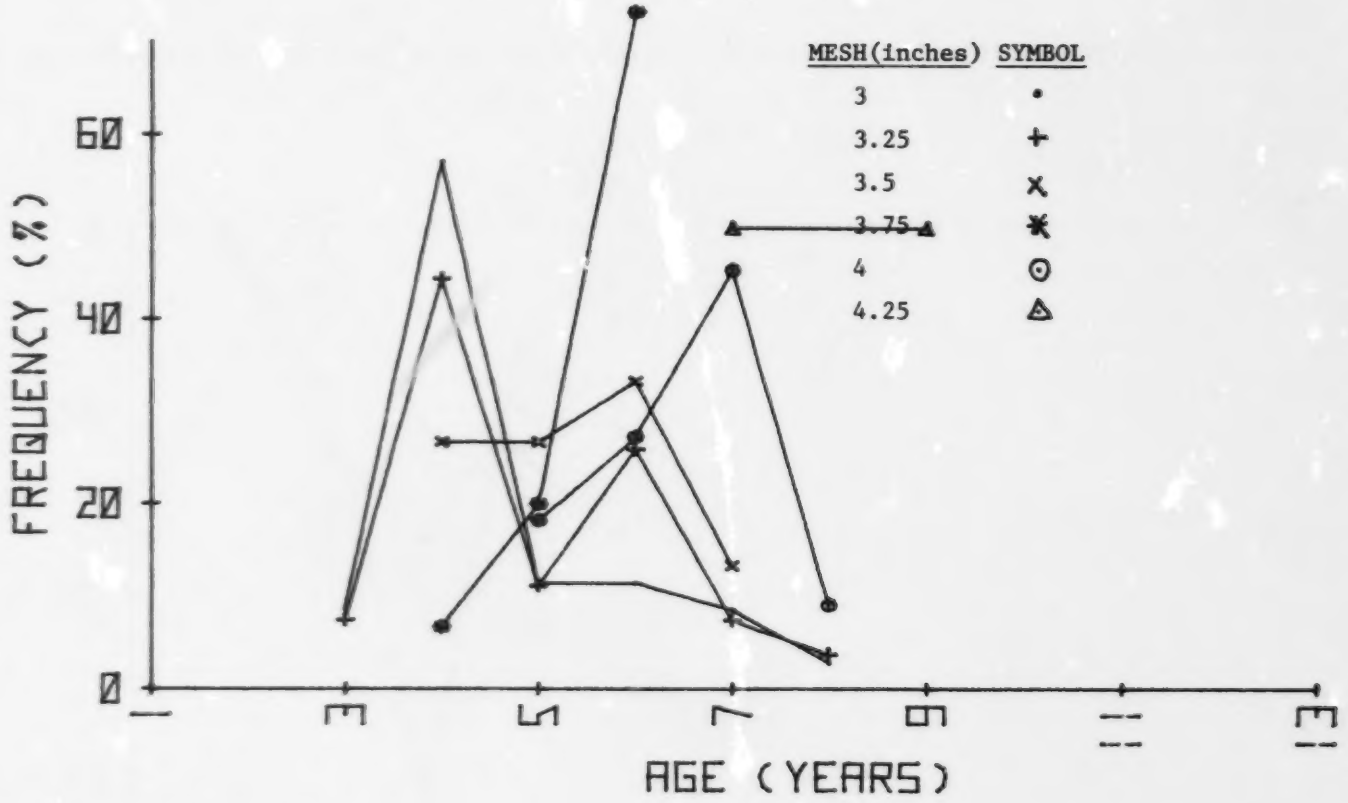

Fig. 35. Effects of mesh size on age frequency distributions of channel walleyes, 1982 .

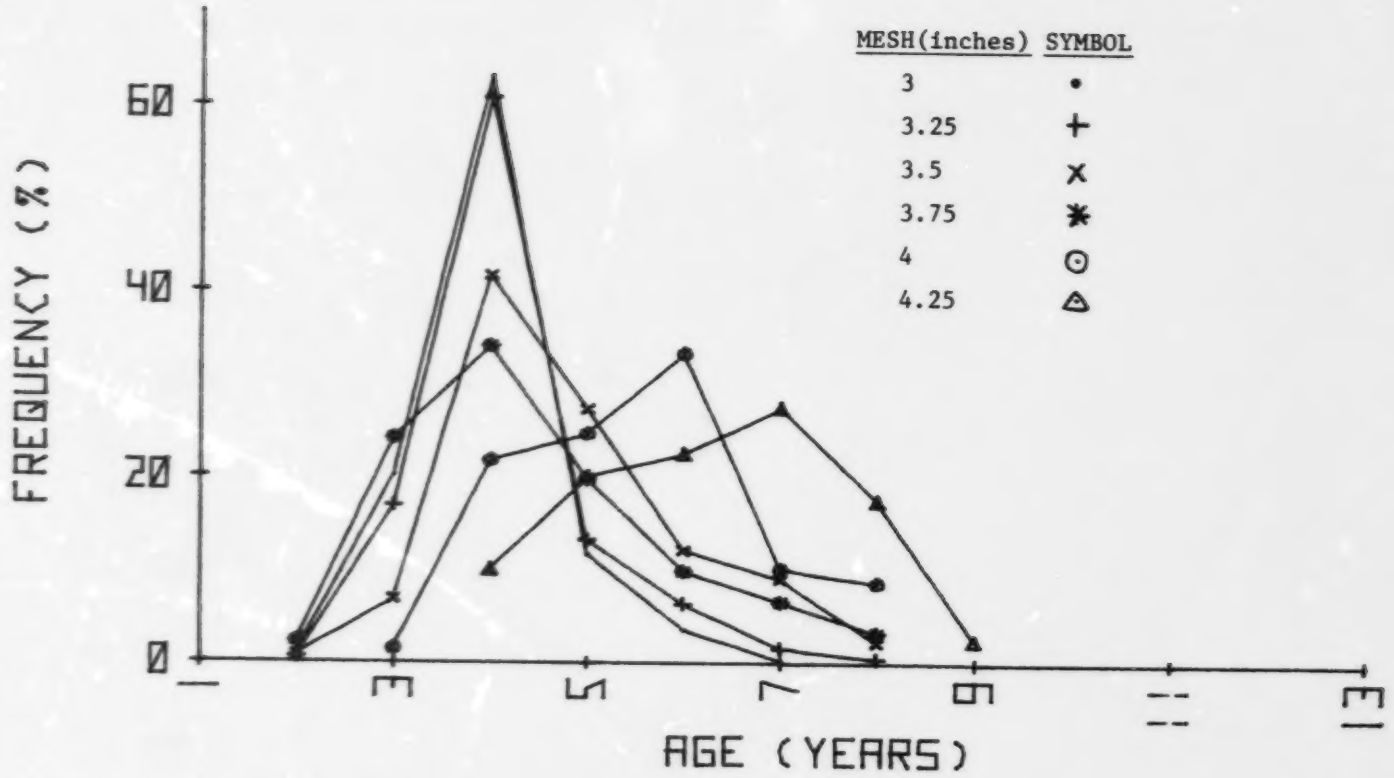

Fig. 36. Effects of mesh size on age frequency distributions of south basin walleyes, 1982.

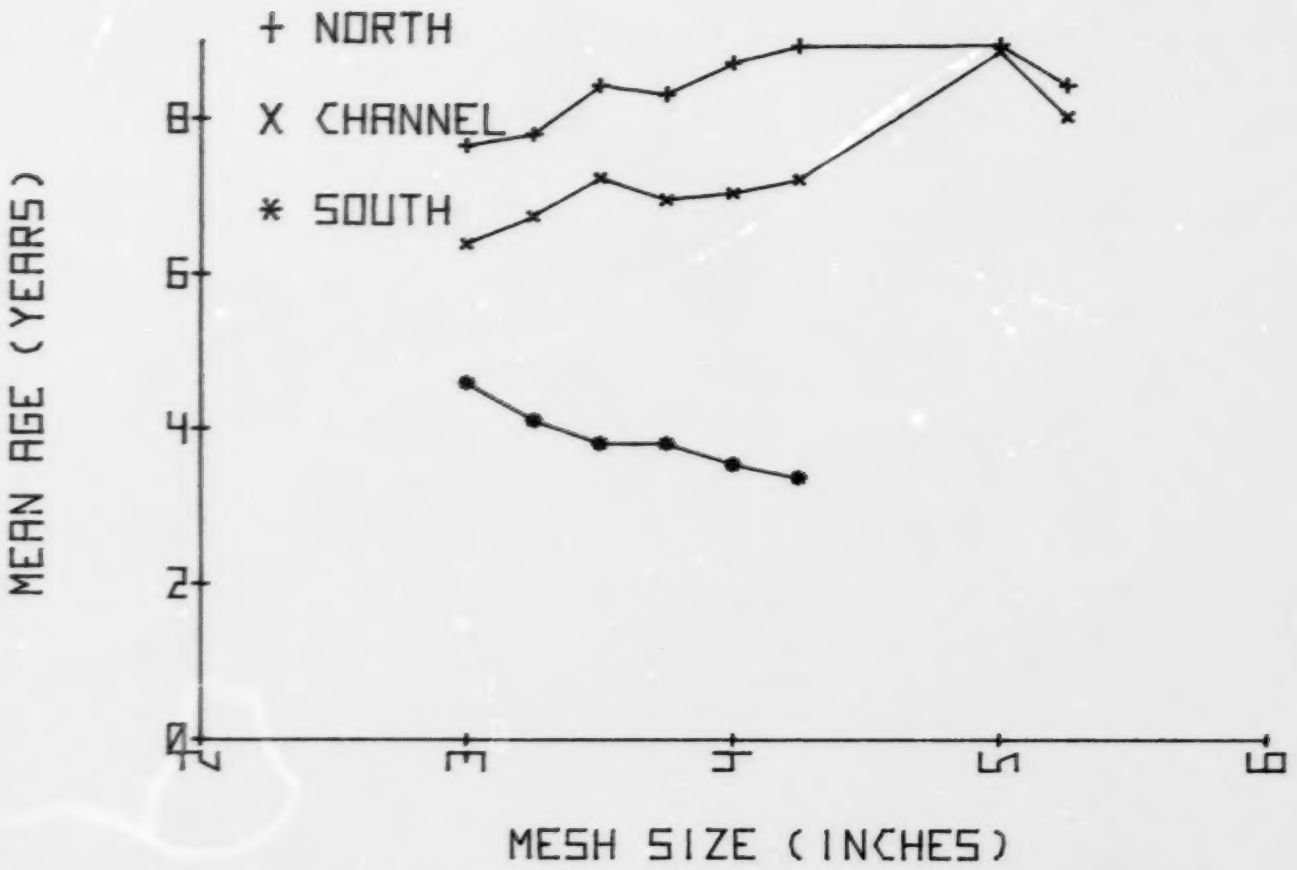

Fig. 37. The relationship of mean ages of saugers and mesh sizes in the three major areas of Lake Winnipeg, 1982.

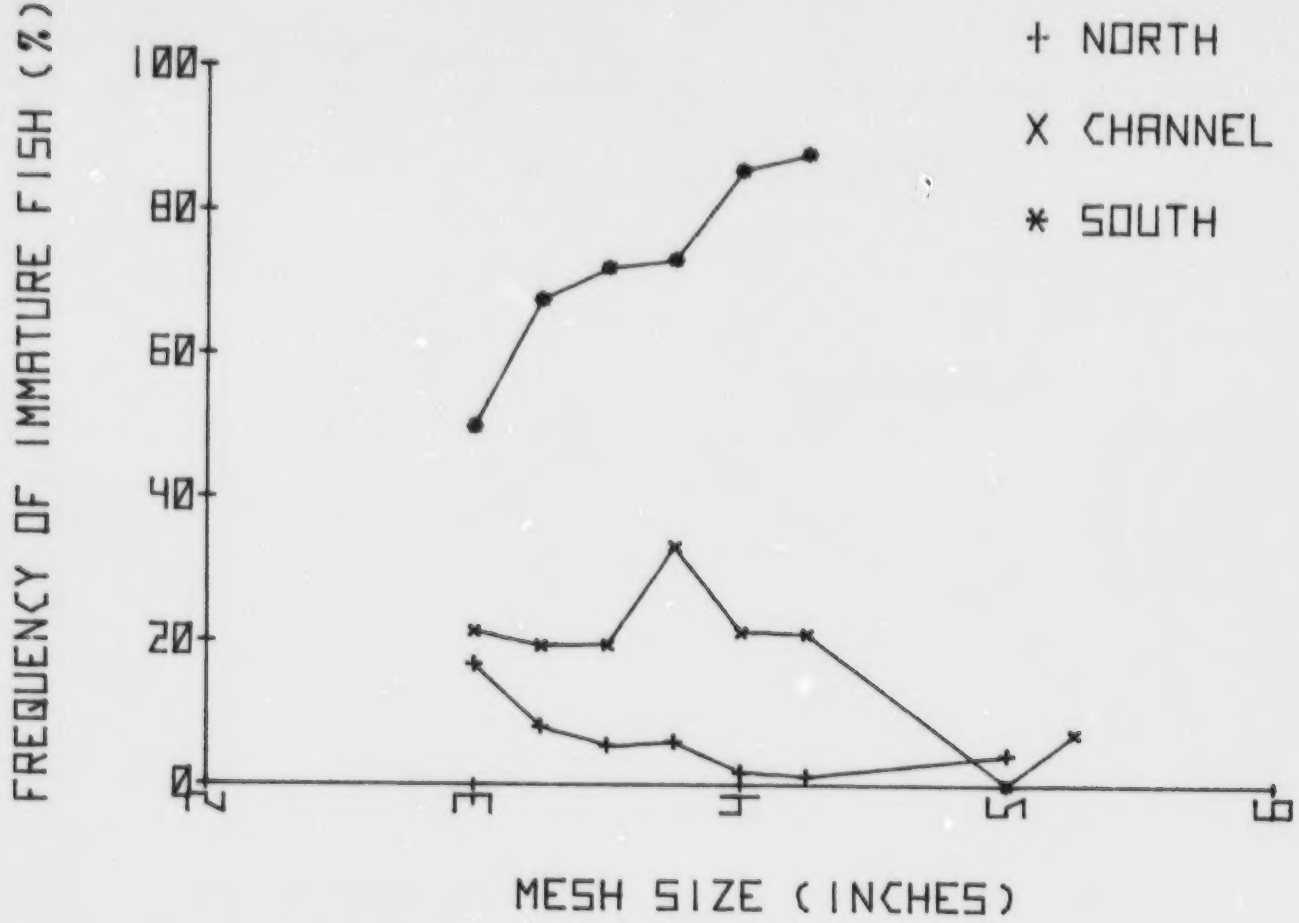

Fig. 38. Changes in frequencies of immature saugers in relation to mesh size in the three major areas of Lake Winnipeg, 1982.

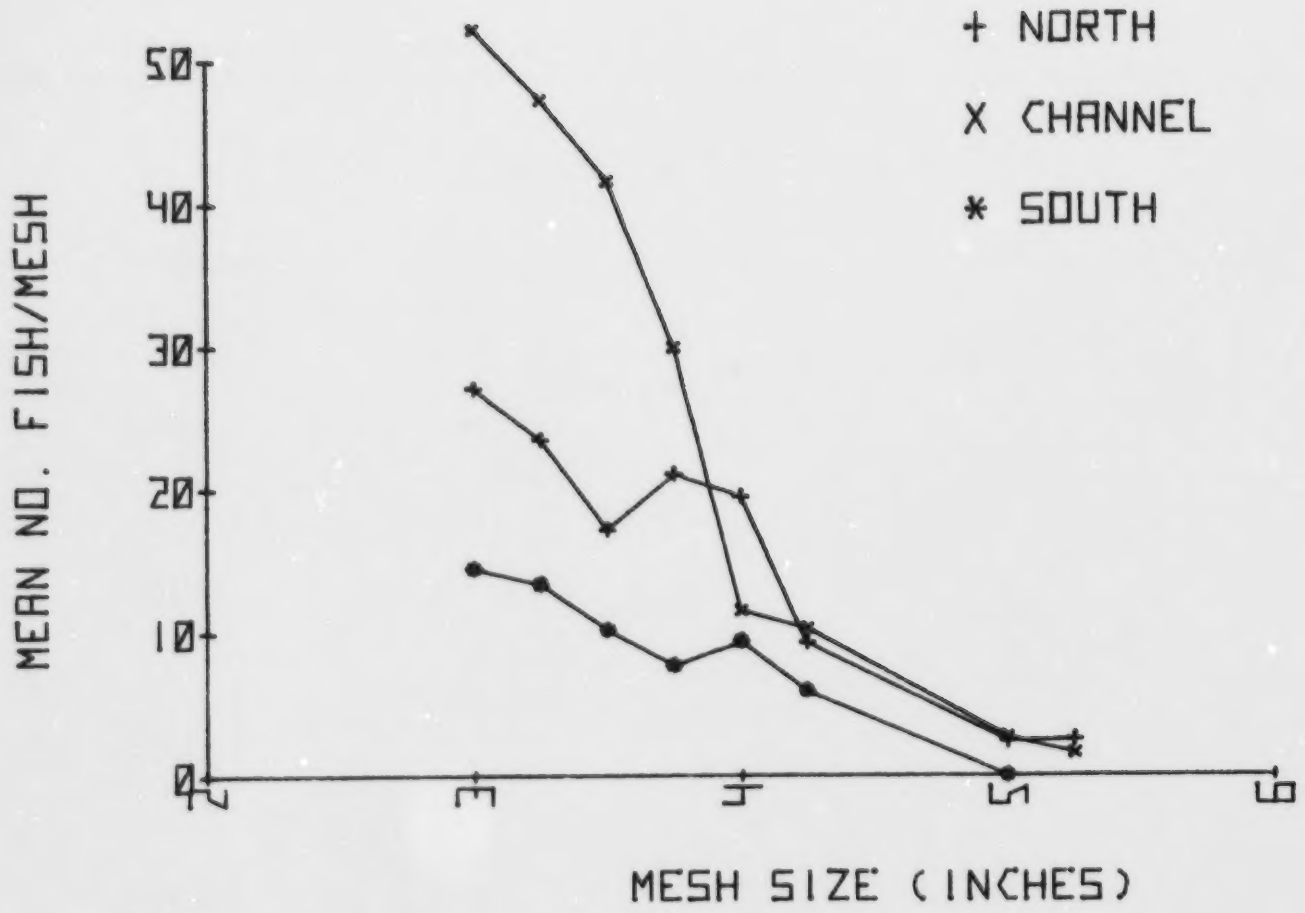

Fig. 39. Effects of mesh size on the mean numbers of saugers caught per net in the three major areas of Lake Winnipeg, 1982.

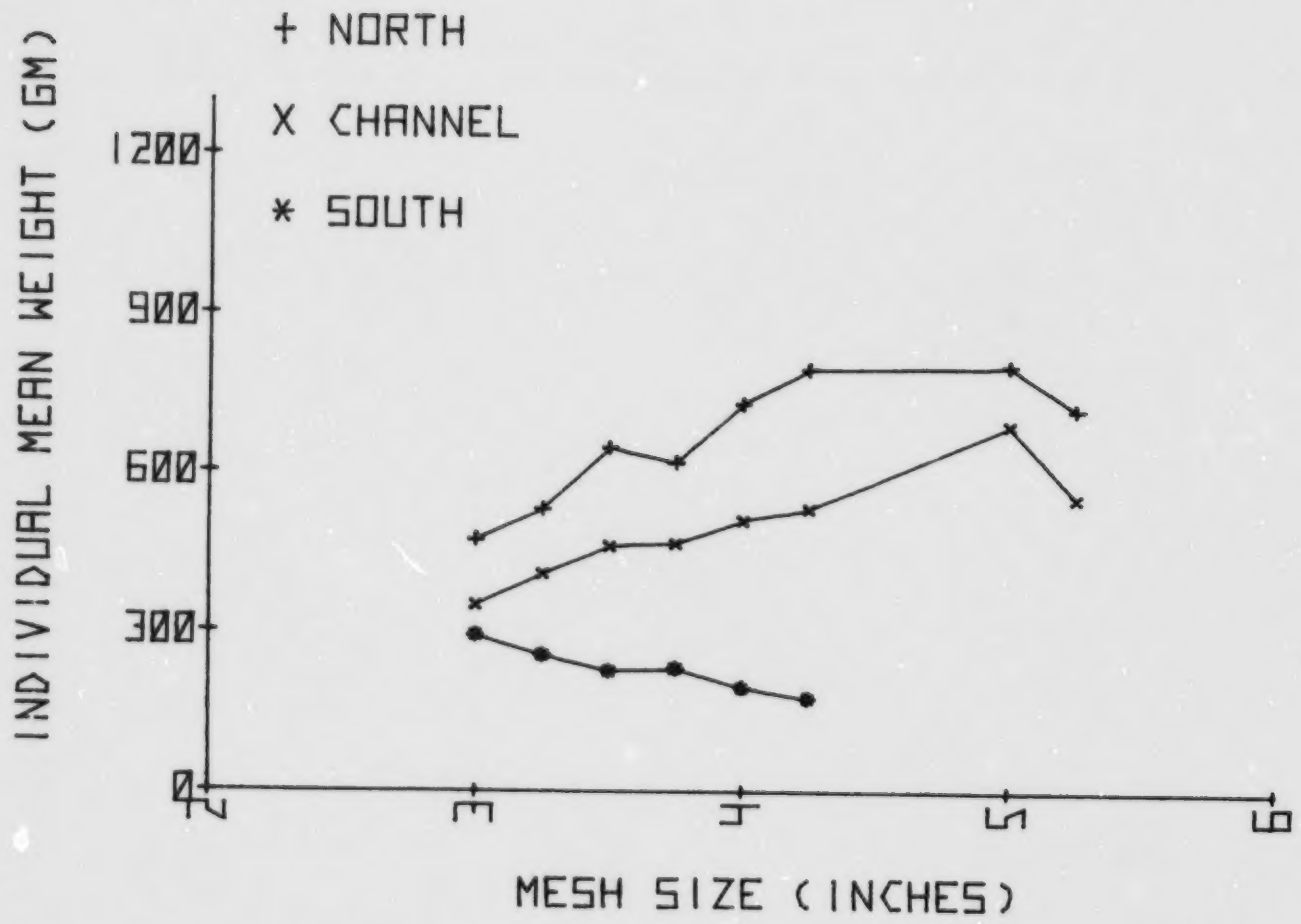

Fig. 40. Effects of mesh size on mean weights of saugers caught in the three major areas of Lake Winnipeg, 1982.

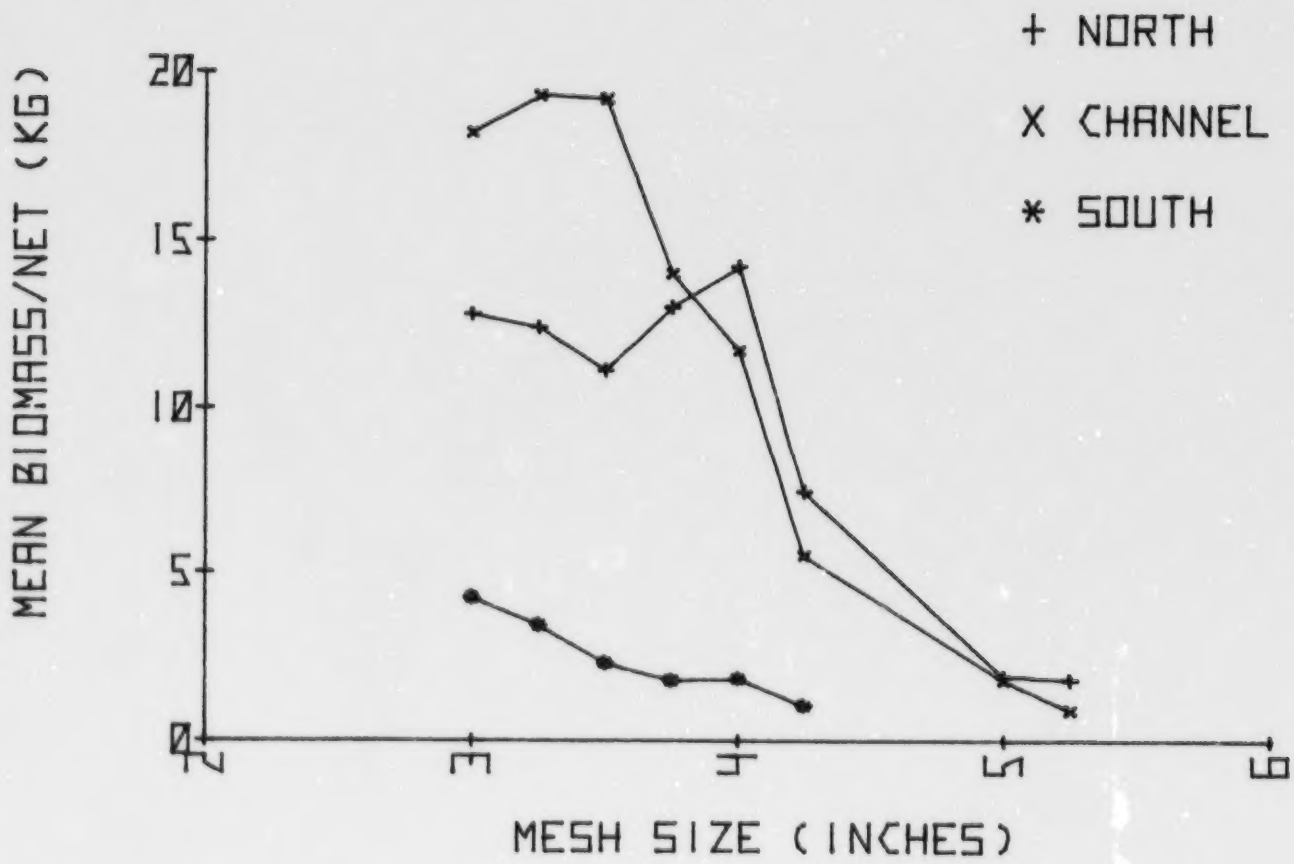

Fig. 41. Effects of mesh size on the mean biomass per net of saugers caught in the three major areas of Lake Winnipeg, 1982.

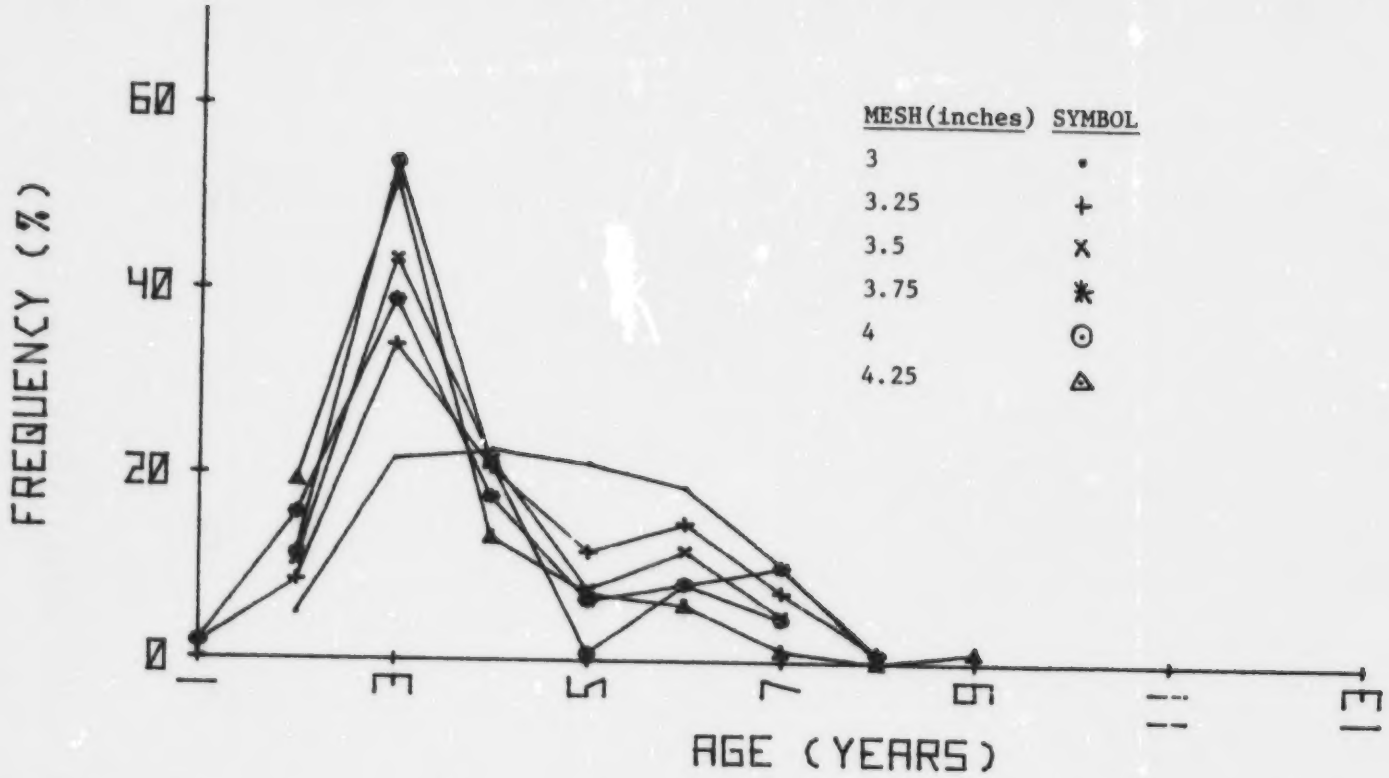

Fig. 42. Effects of mesh size on age frequency distributions of south basin saugers, 1982.

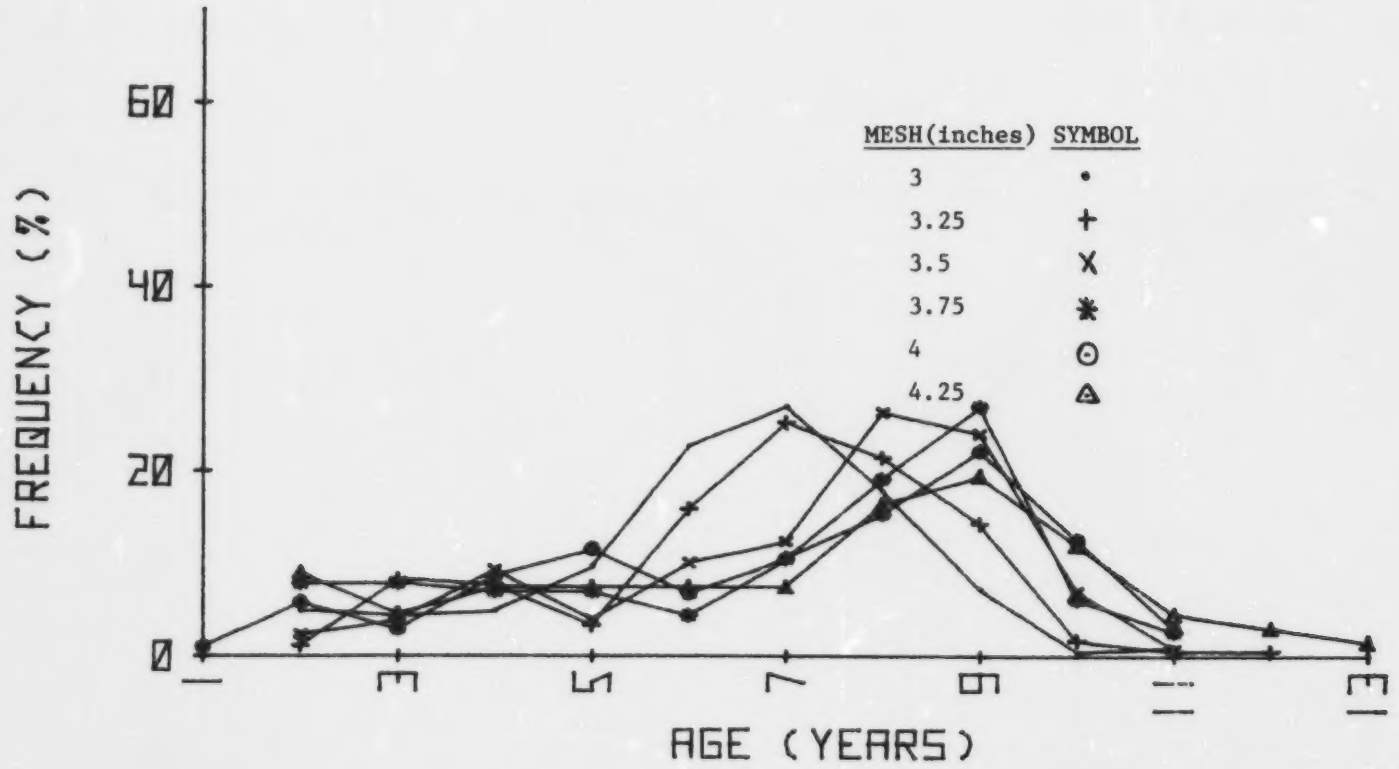

Fig. 43. Effects of mesh size on age frequency distributions of channel saugers, 1982.

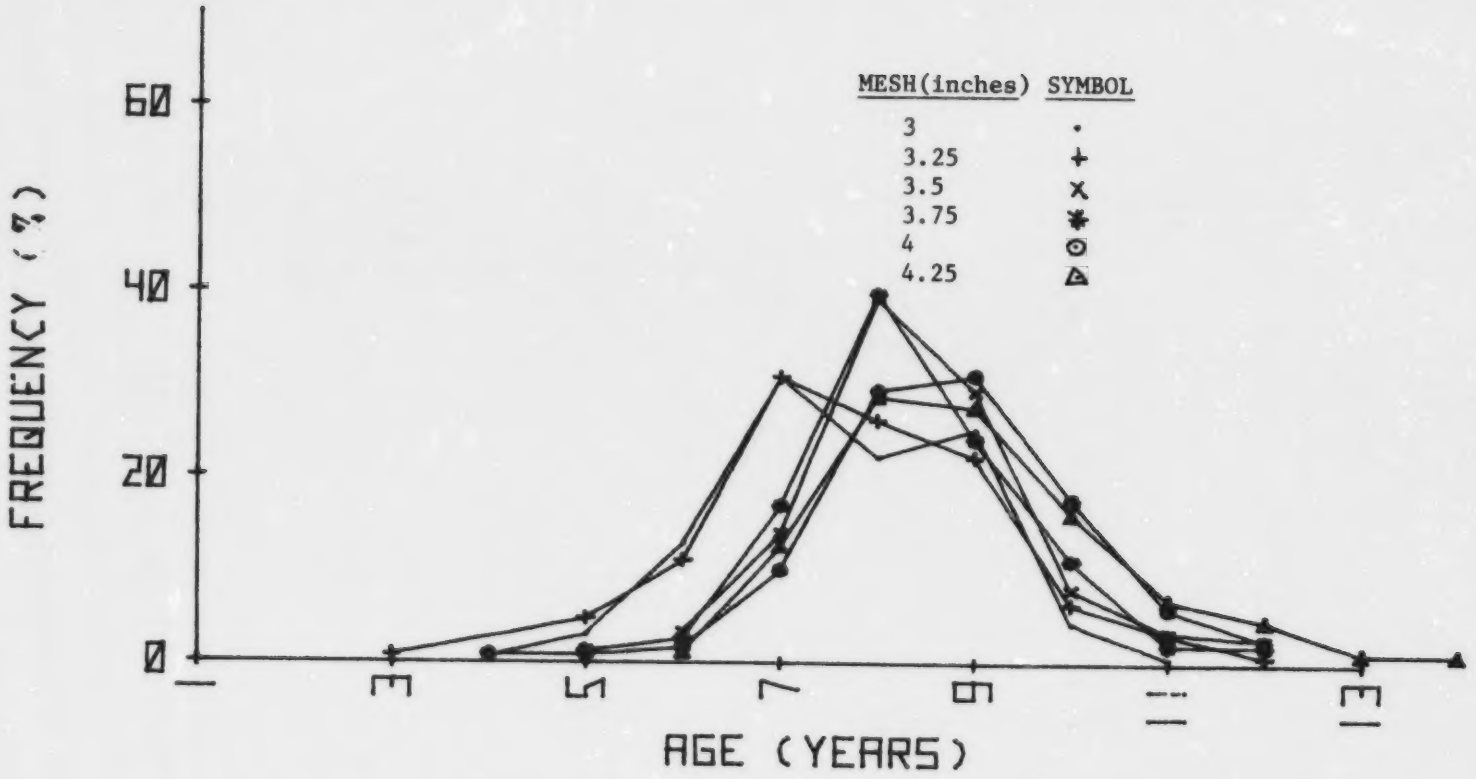

Fig. 44. Effects of mesh size on age frequency distributions of north basin saugers, 1982.

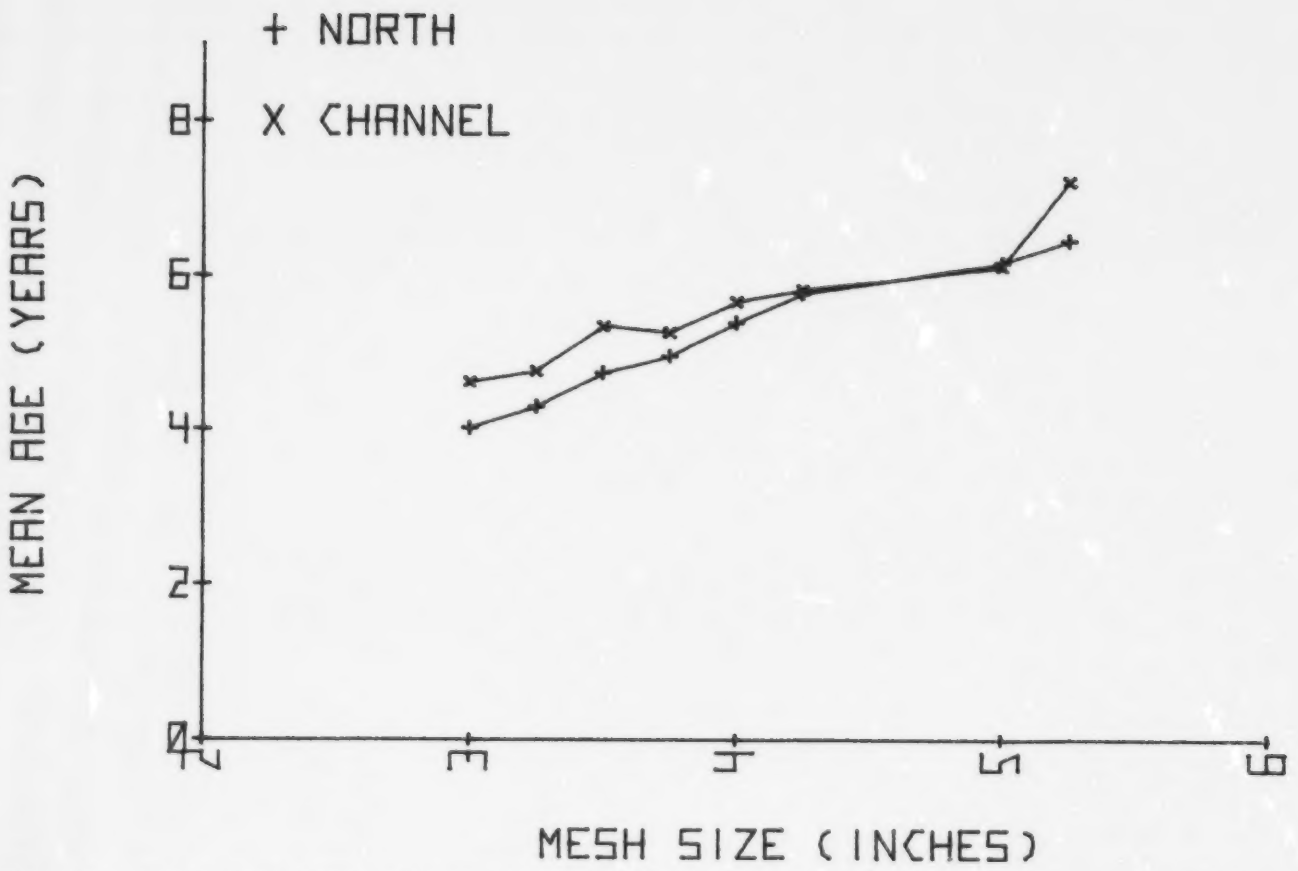

Fig. 45. The relationship of mean ages of whitefish and mesh sizes in the north basin and channel area of Lake Winnipeg, 1982.

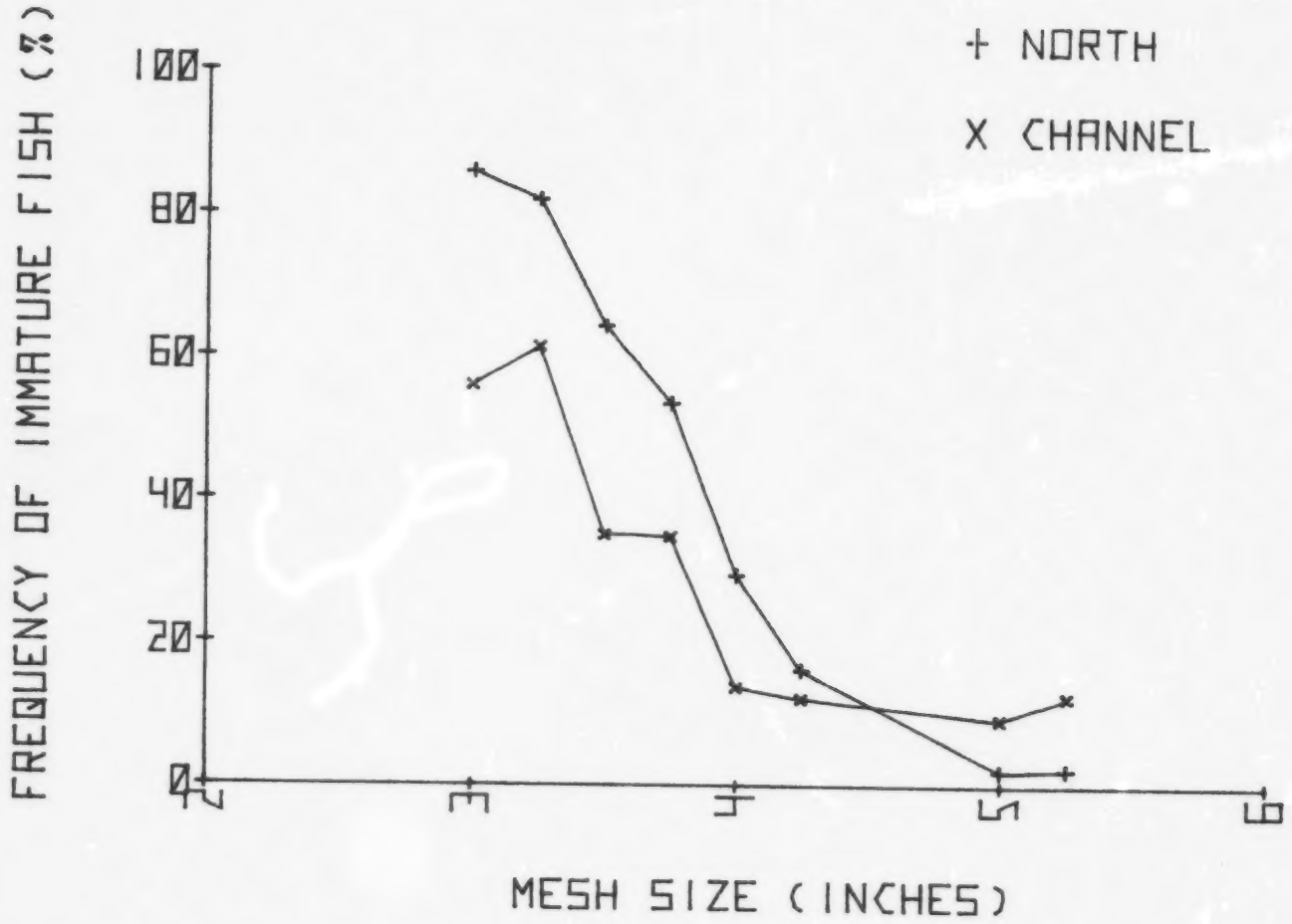

Fig. 46. Changes in frequencies of immature whitefish in relation to mesh size in the channel area and north basin of Lake Winnipeg, 1982.

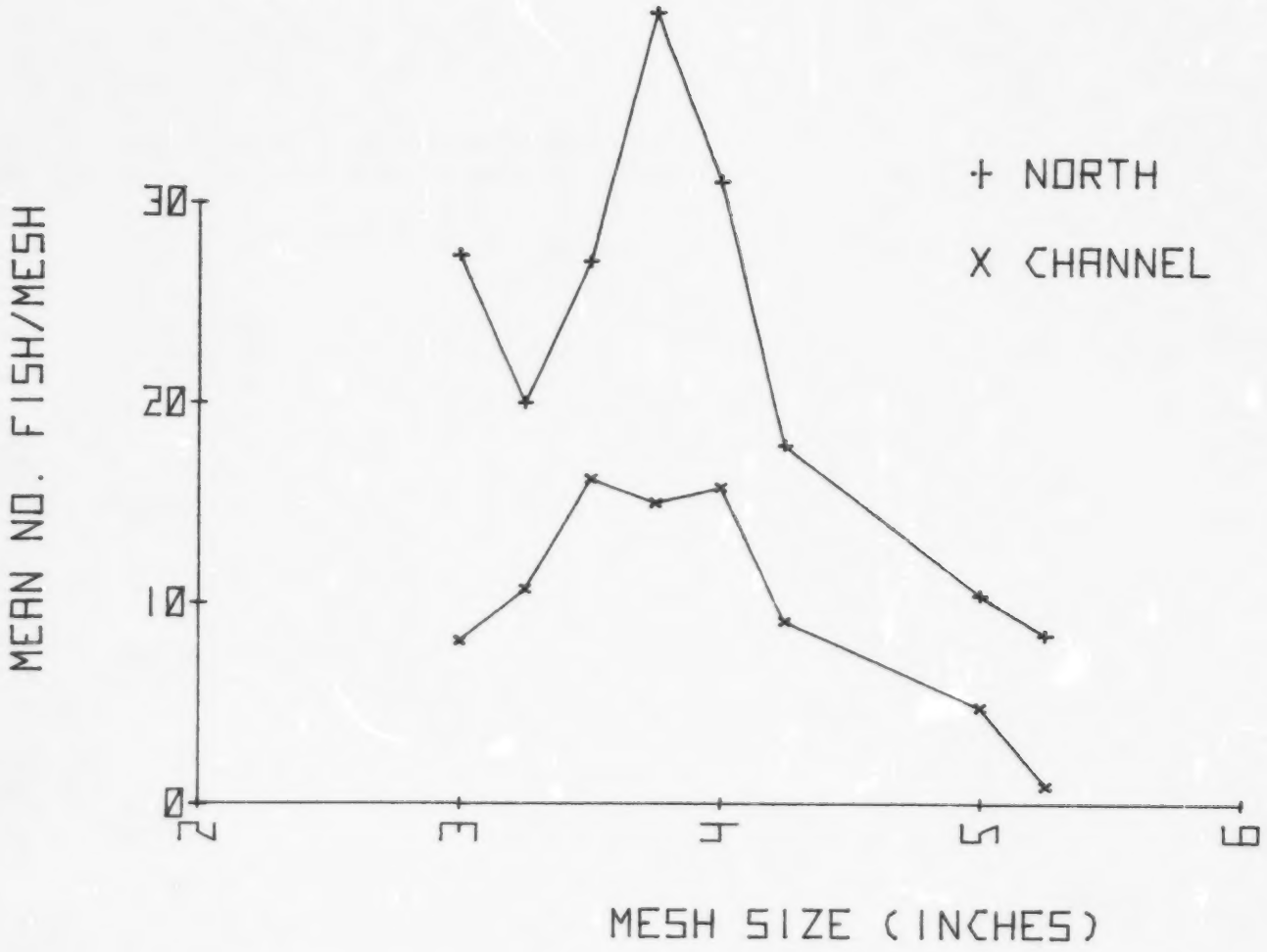

Fig. 47. Effects of mesh size on the mean numbers of whitefish caught per net in the channel area and north basin of Lake Winnipeg, 1982.

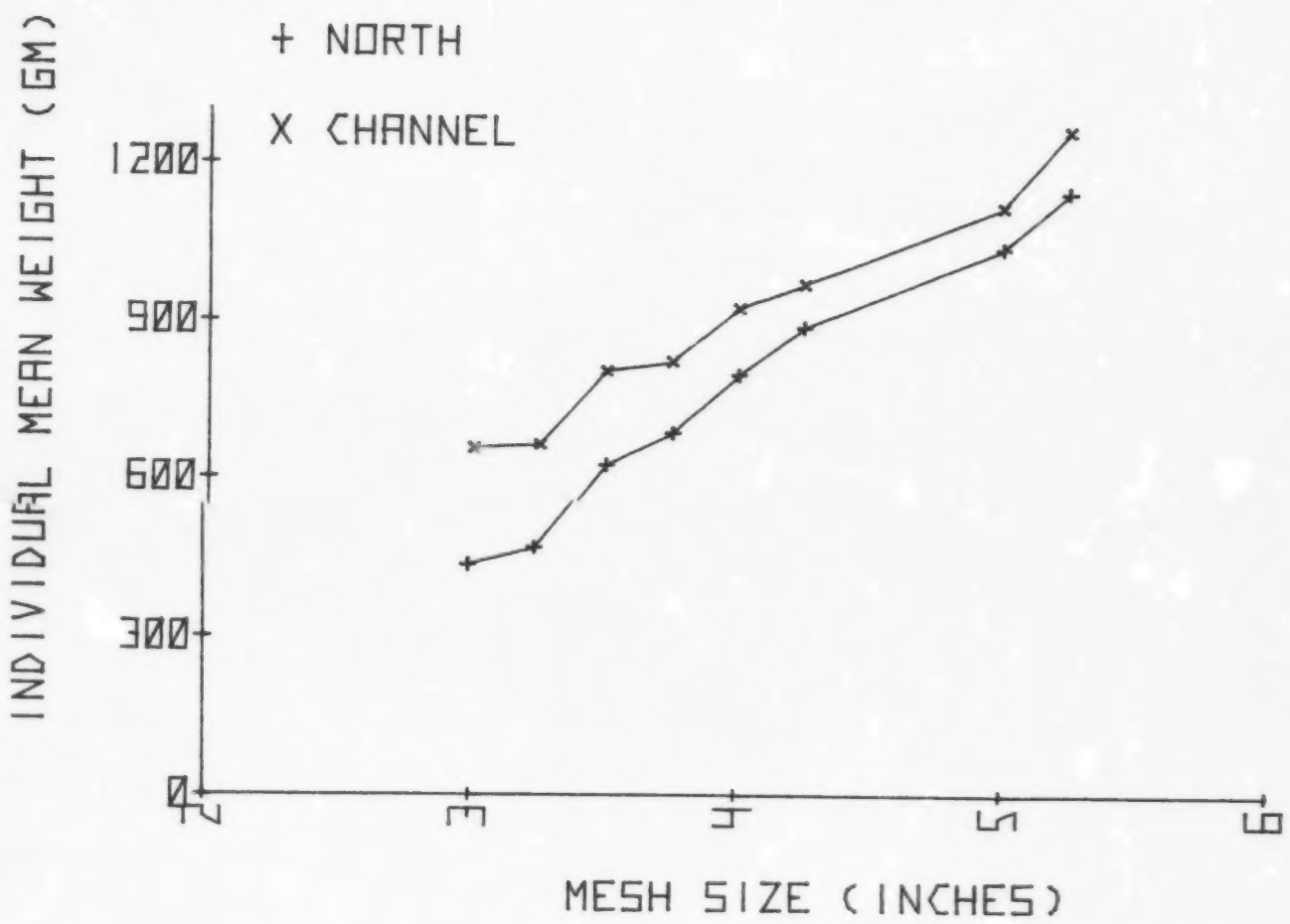

Fig. 48. Effects of mesh size on mean weights of whitefish caught in the channel area and north basin of Lake Winnipeg, 1982.

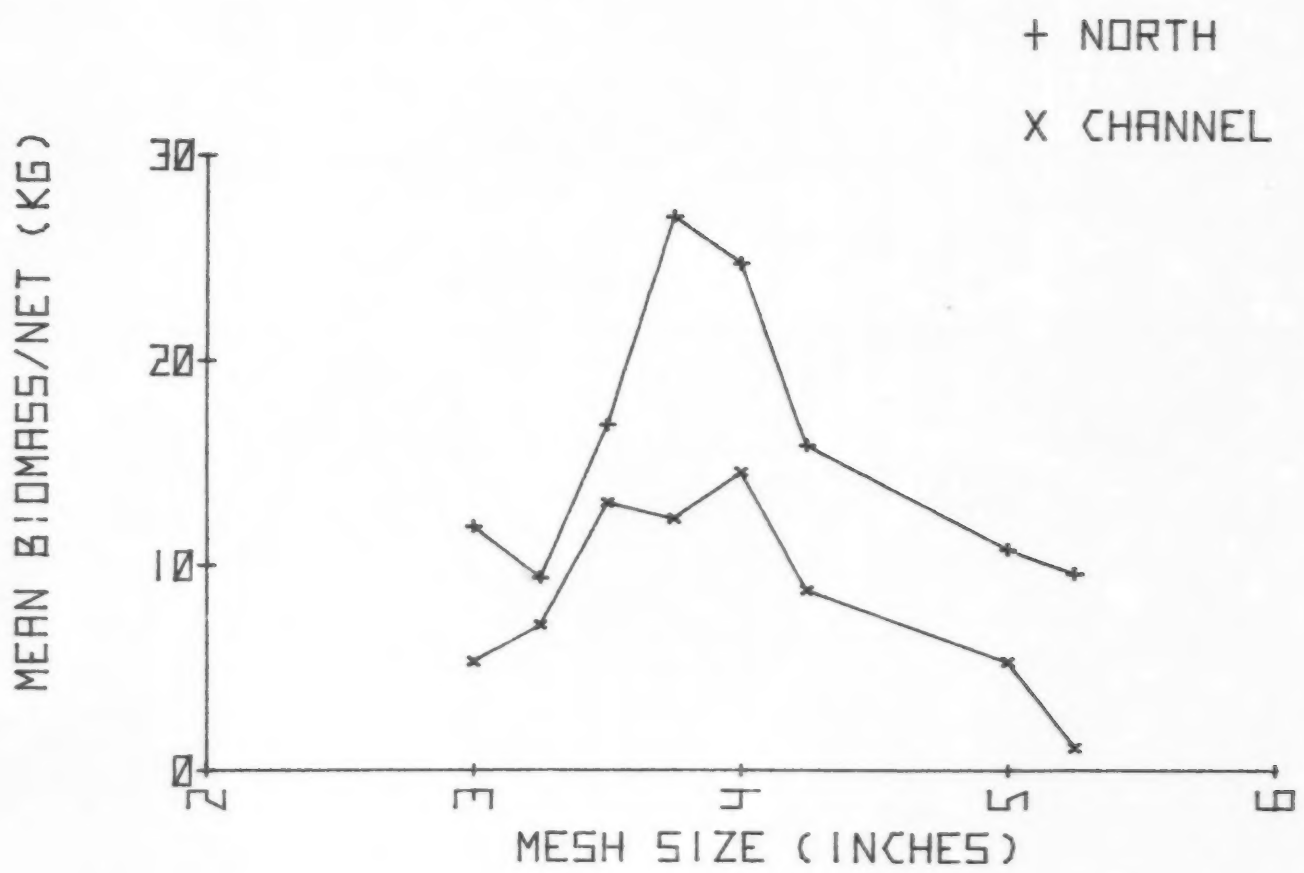

Fig. 49. Effects of mesh size on the mean biomass per net of whitefish caught in the channel and north basin of Lake Winnipeg, 1982.

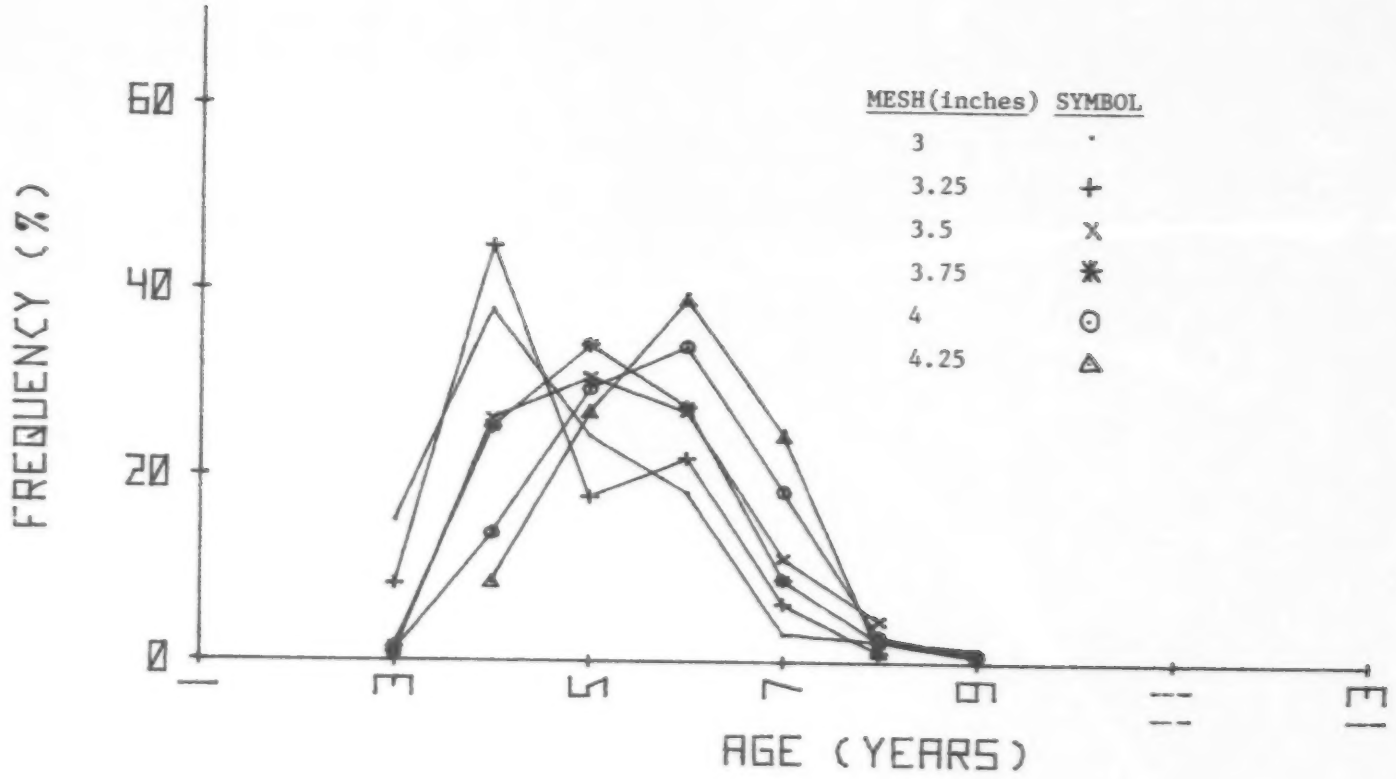

Fig. 50. Effects of mesh size on age frequency distributions of channel whitefish, 1982.

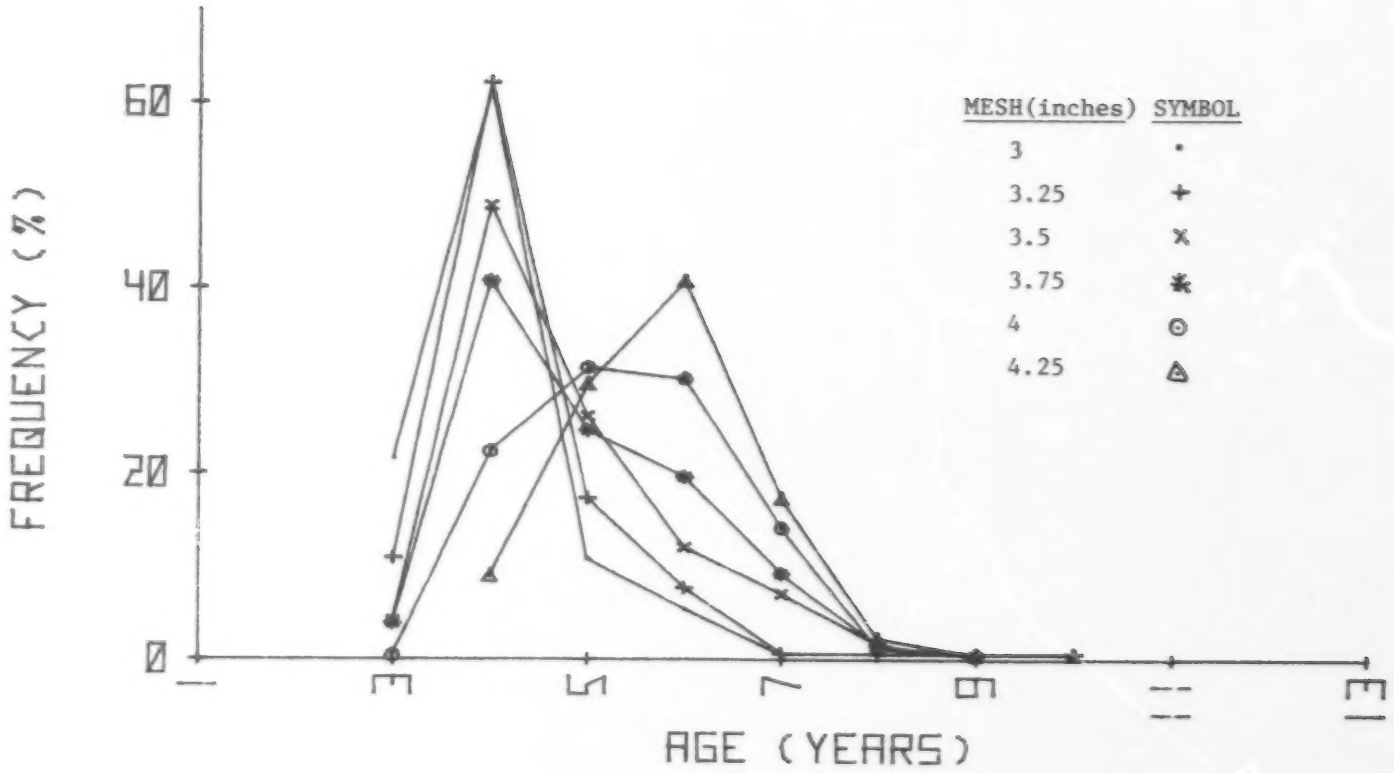

Fig. 51. Effects of mesh size on age frequency distributions of north basin whitefish, 1982.

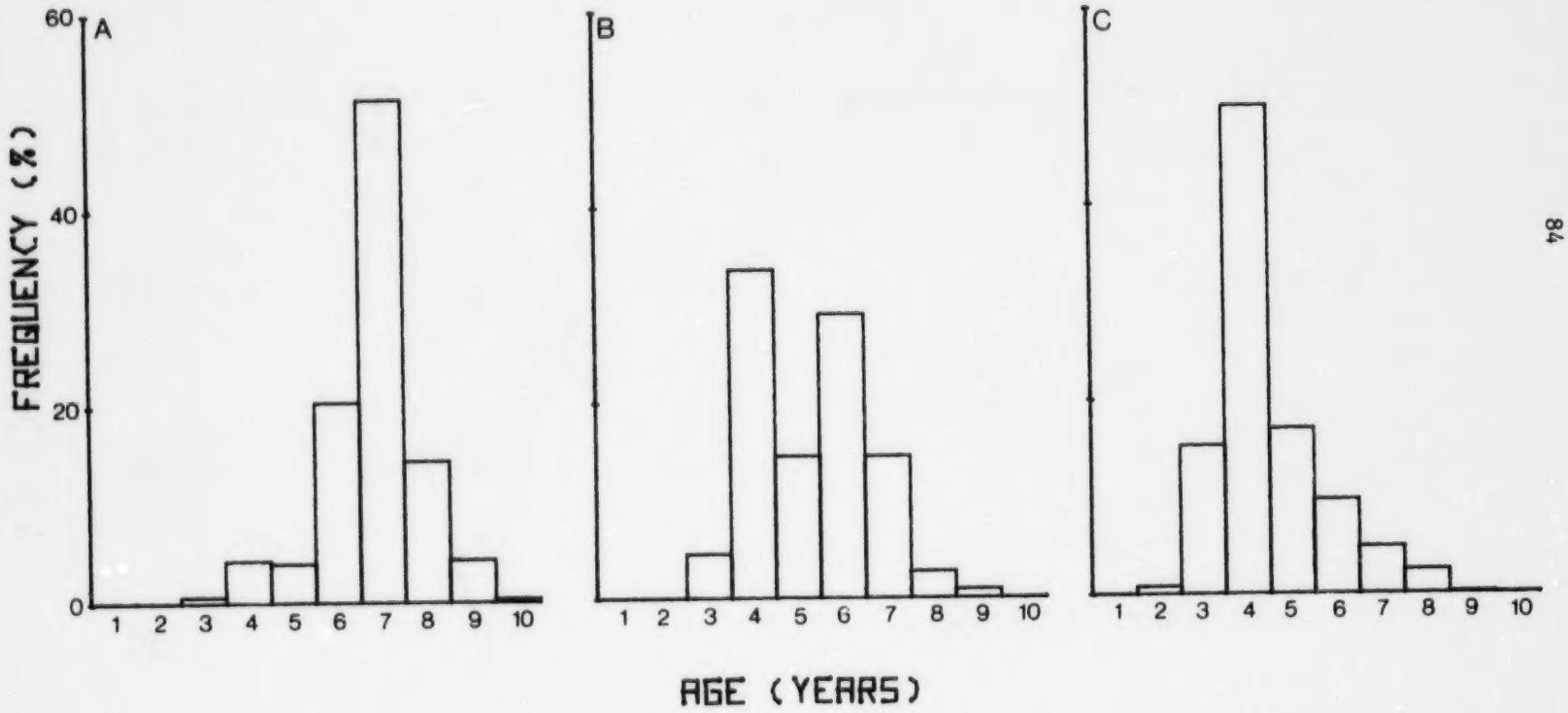

Fig. 52. Experimental age compositions of walleyes from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg.

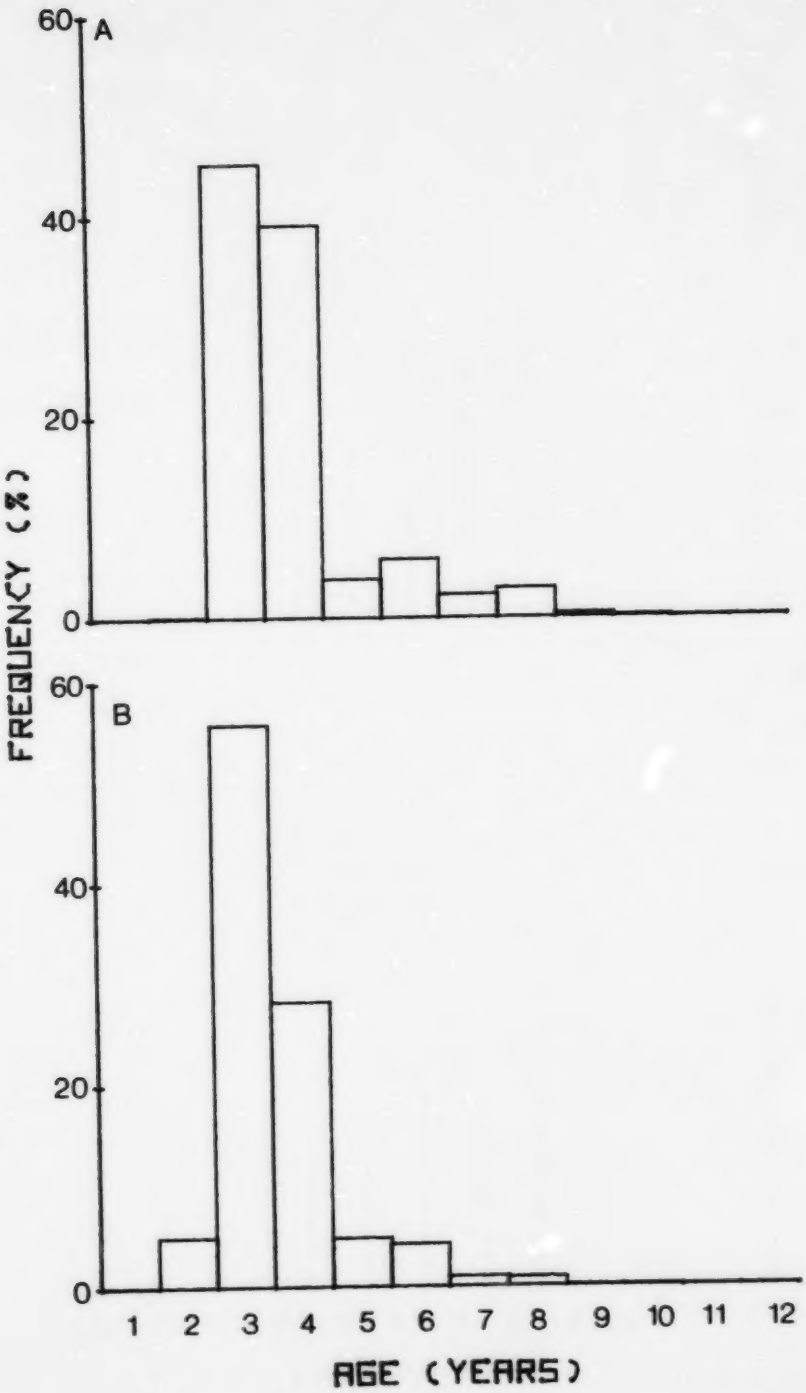

Fig. 53. Age compositions of commercially caught walleyes from the south basin of Lake Winnipeg. A - summer, B - fall.

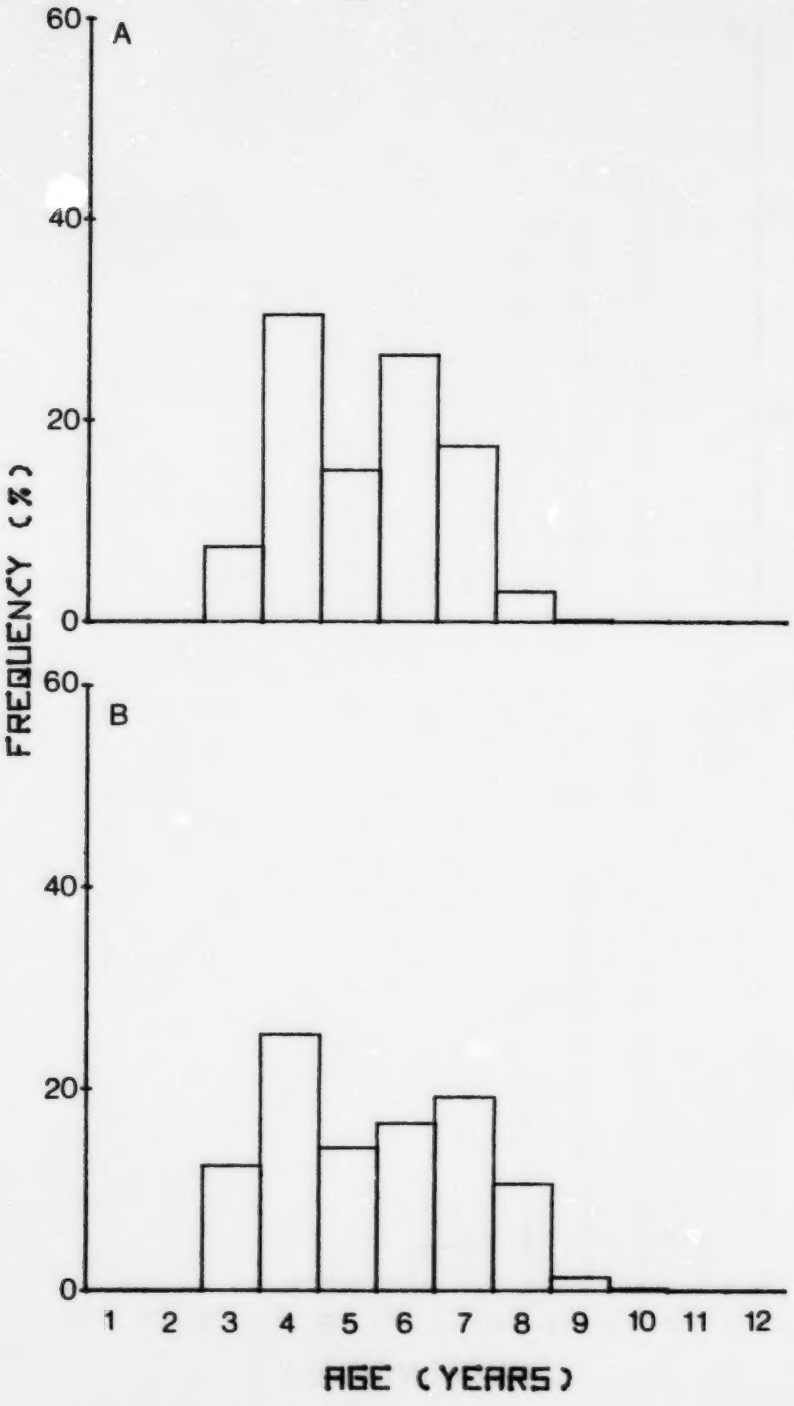

Fig. 54. Age compositions of commercially caught walleyes from the channel area of Lake Winnipeg. A - summer, B - fall.

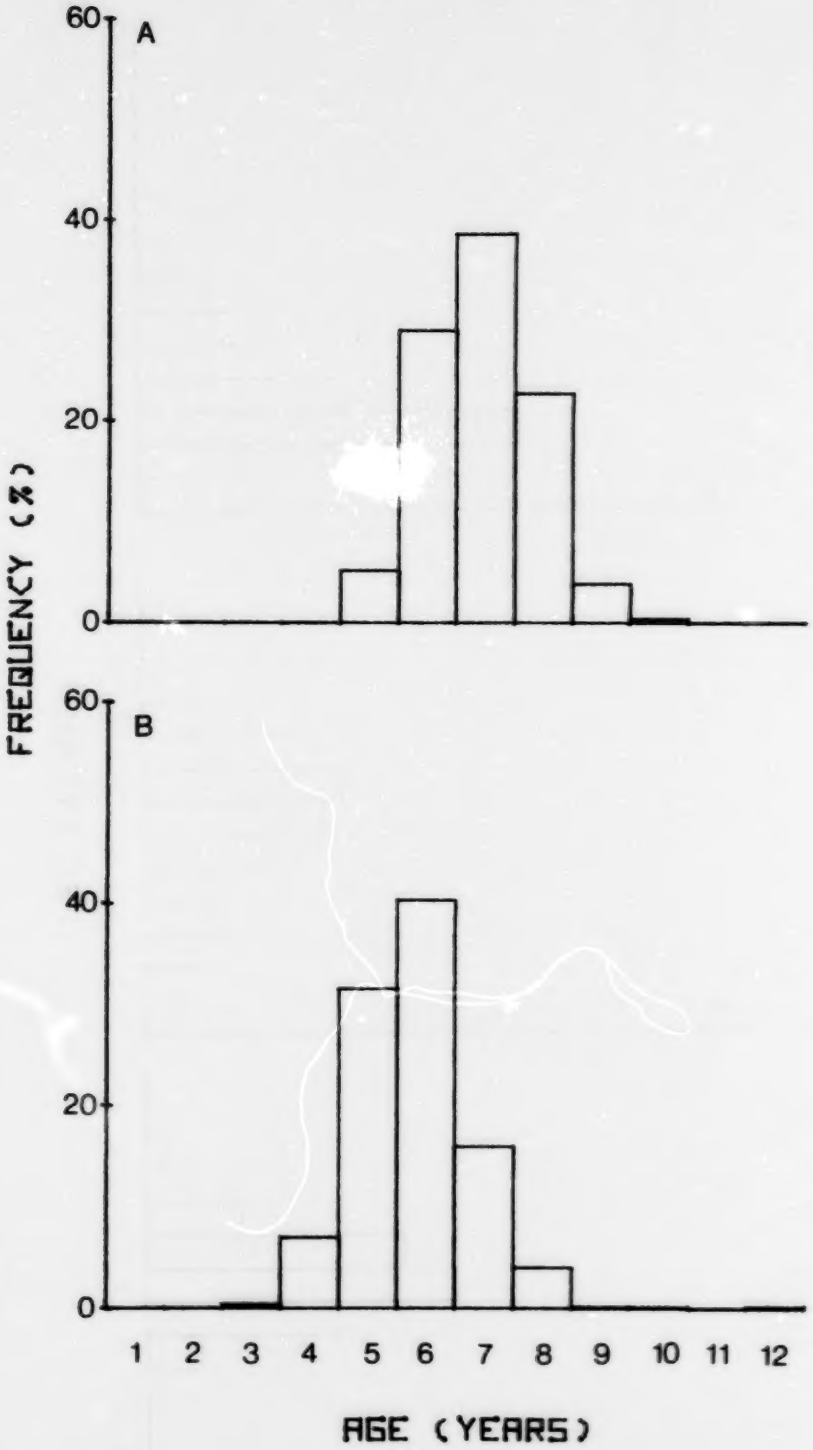

Fig. 55. Age compositions of commercially caught walleyes from the north basin of Lake Winnipeg. A - summer, B - fall.

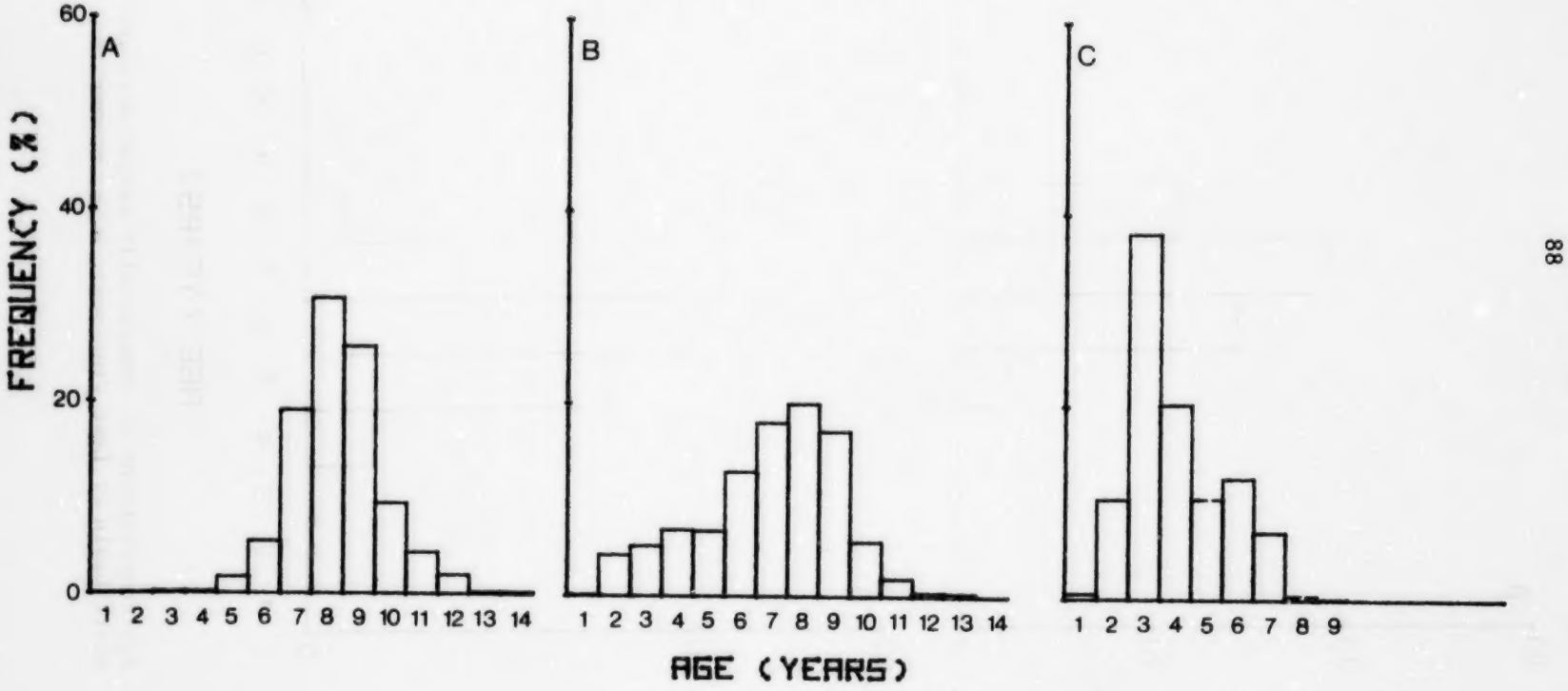

Fig. 56. Experimental age compositions of saugers from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg.

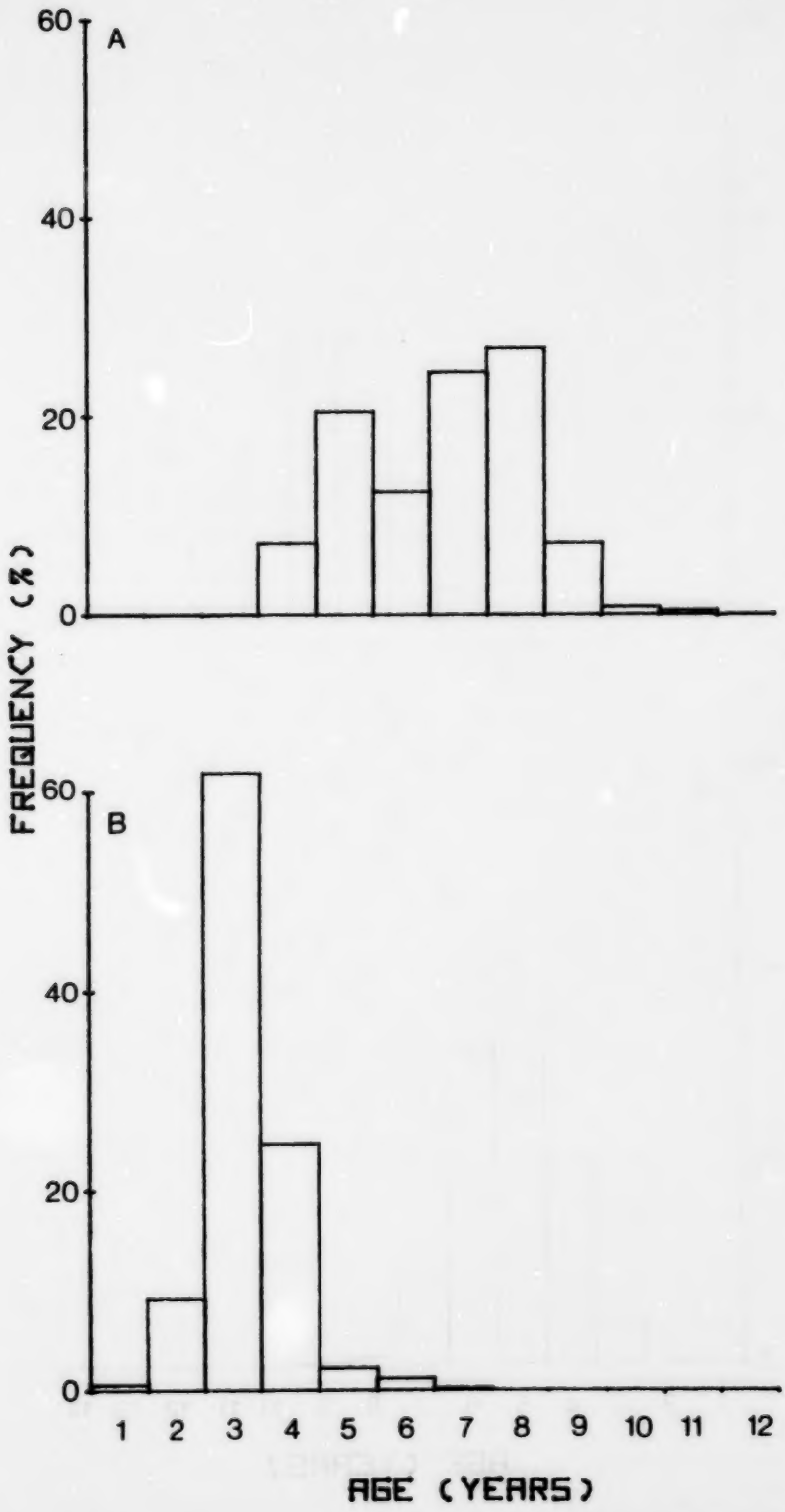

Fig. 57. Age compositions of commercially caught saugers from the south basin of Lake Winnipeg in summer (A) and fall (B).

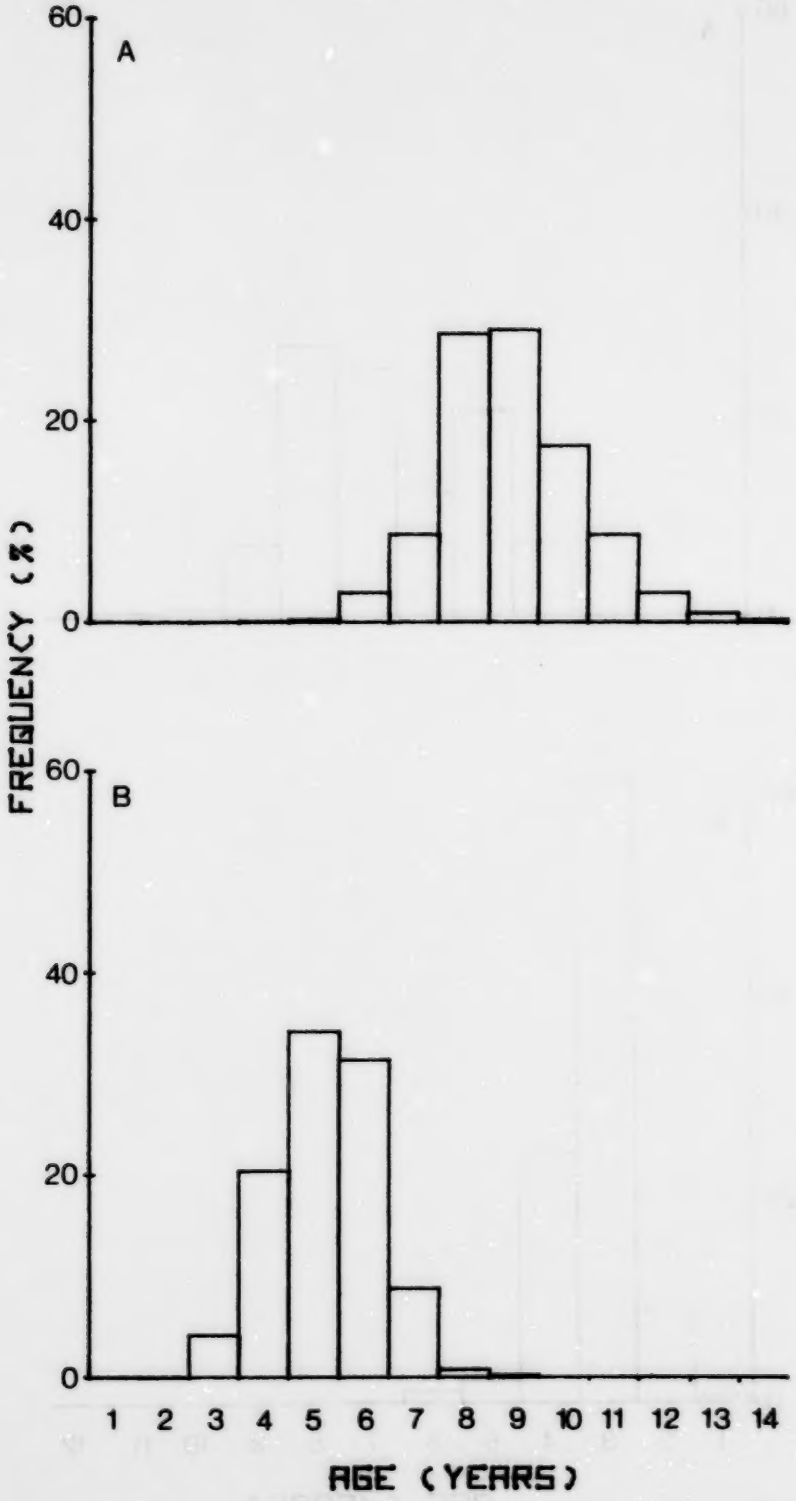

Fig. 58. Age compositions of commercially caught saugers from the channel area of Lake Winnipeg in summer (A) and fall (B).

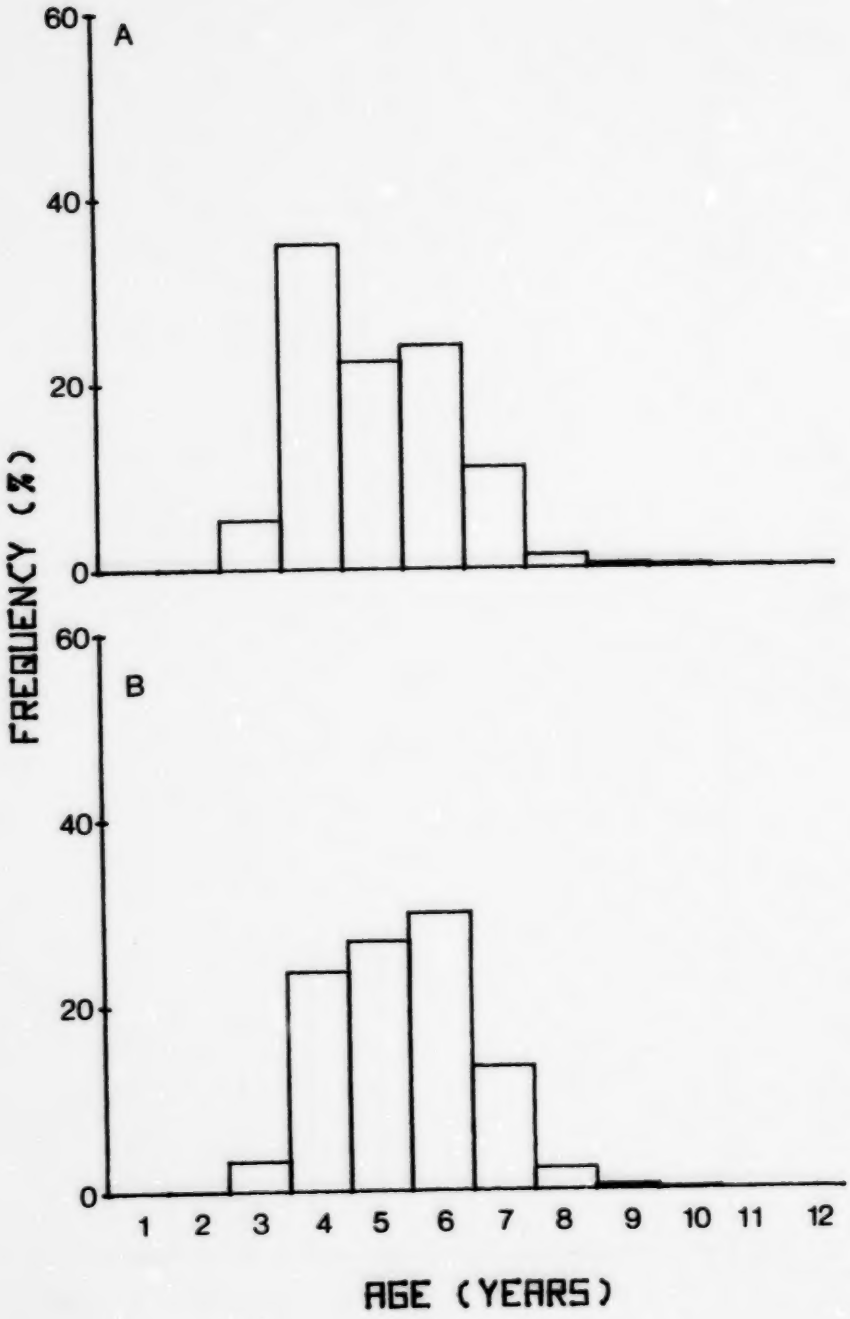

Fig. 59. Experimental age compositions of whitefish from the north basin (A) and channel (B) area of Lake Winnipeg.

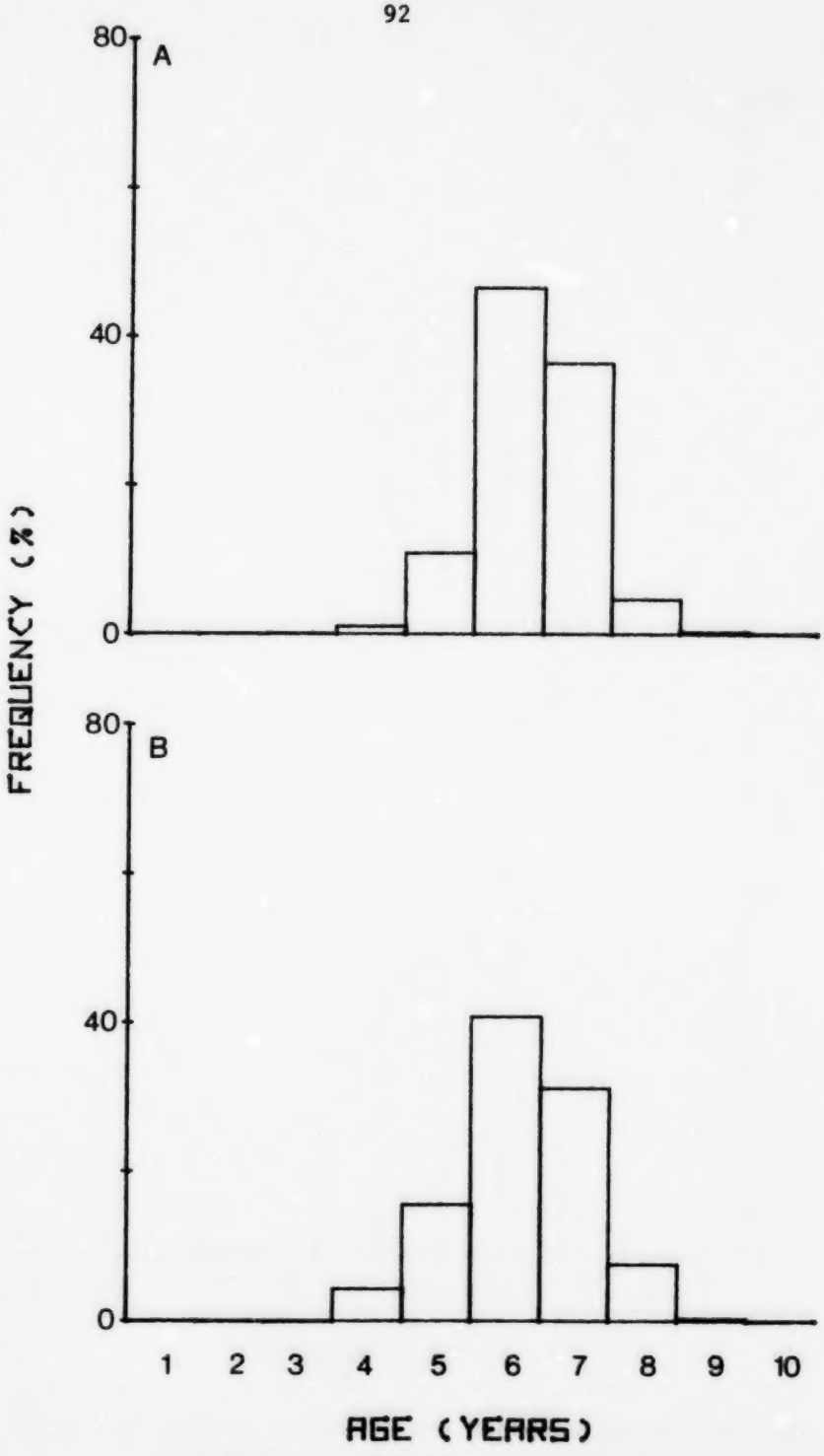

Fig. 60. Age compositions of commercially caught whitefish. A - north basin, summer; B - channel, summer.

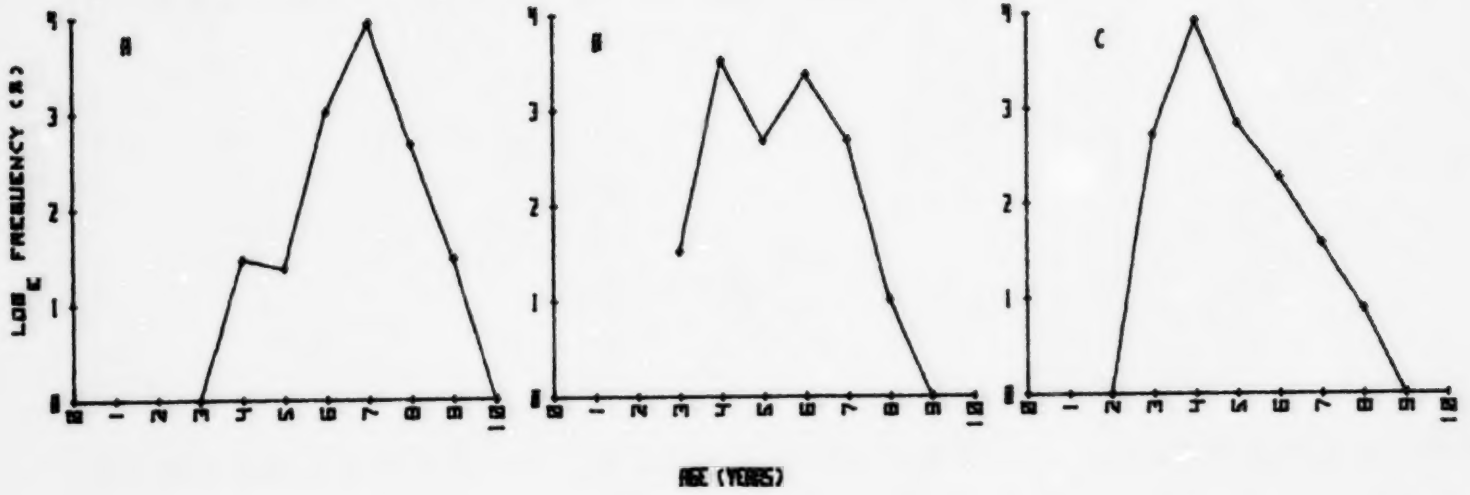

Fig. 61. Catch curves of experimentally caught walleyes from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg.

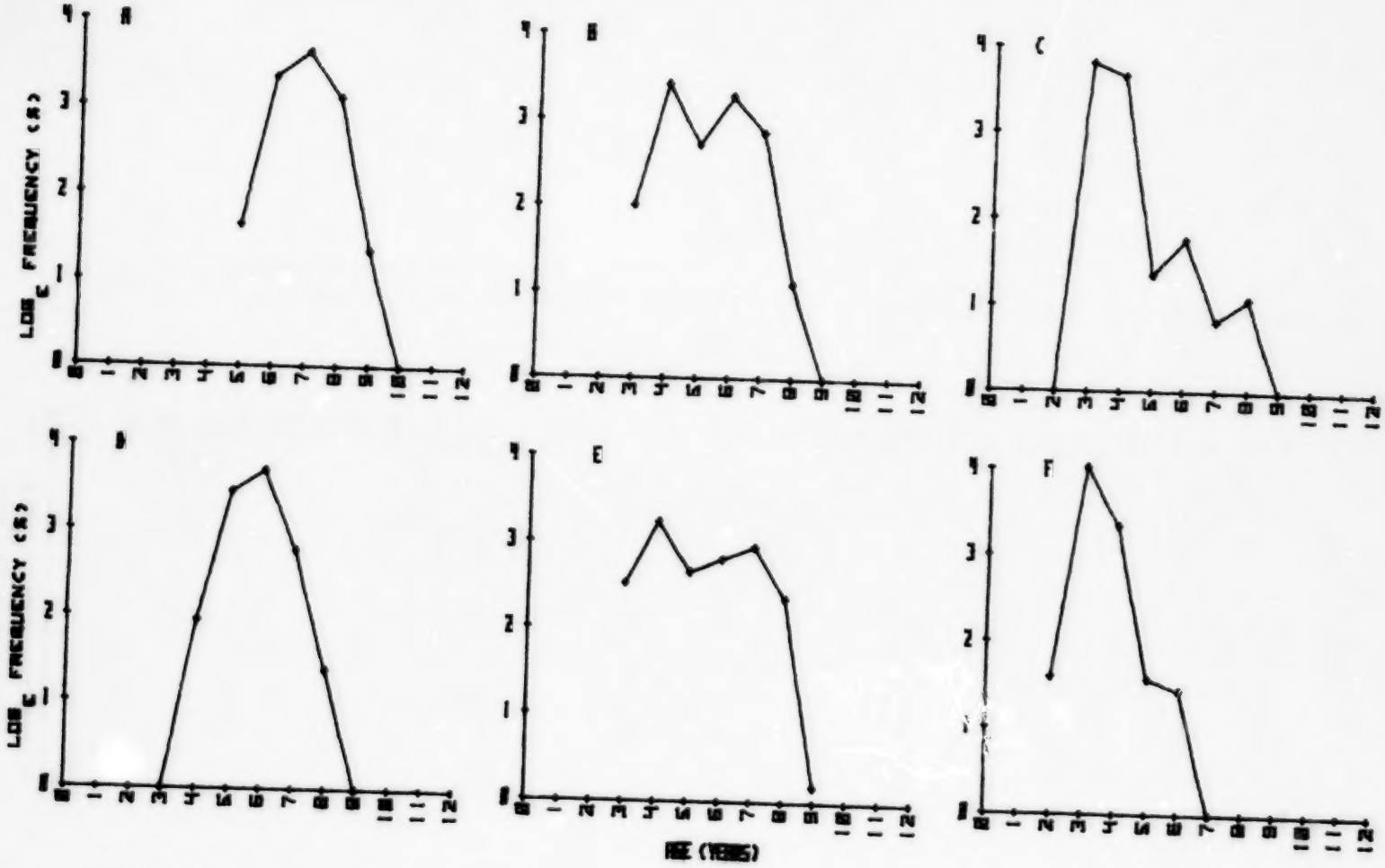

Fig. 62. Catch curves of commercially caught walleyes from the north basin (A, D), channel area (B, E) and south basin (C, F) in summer (A-C) and fall (D-F).

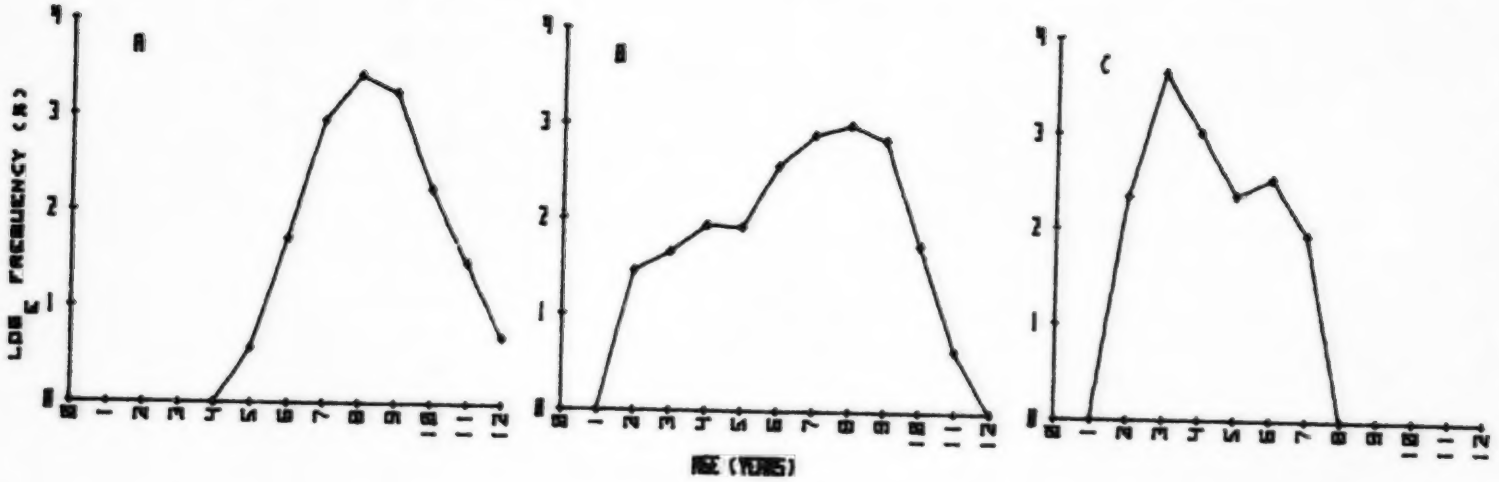

Fig. 63. Catch curves of experimentally caught saugers from the north basin (A), channel area (B) and south basin (C) of Lake Winnipeg.

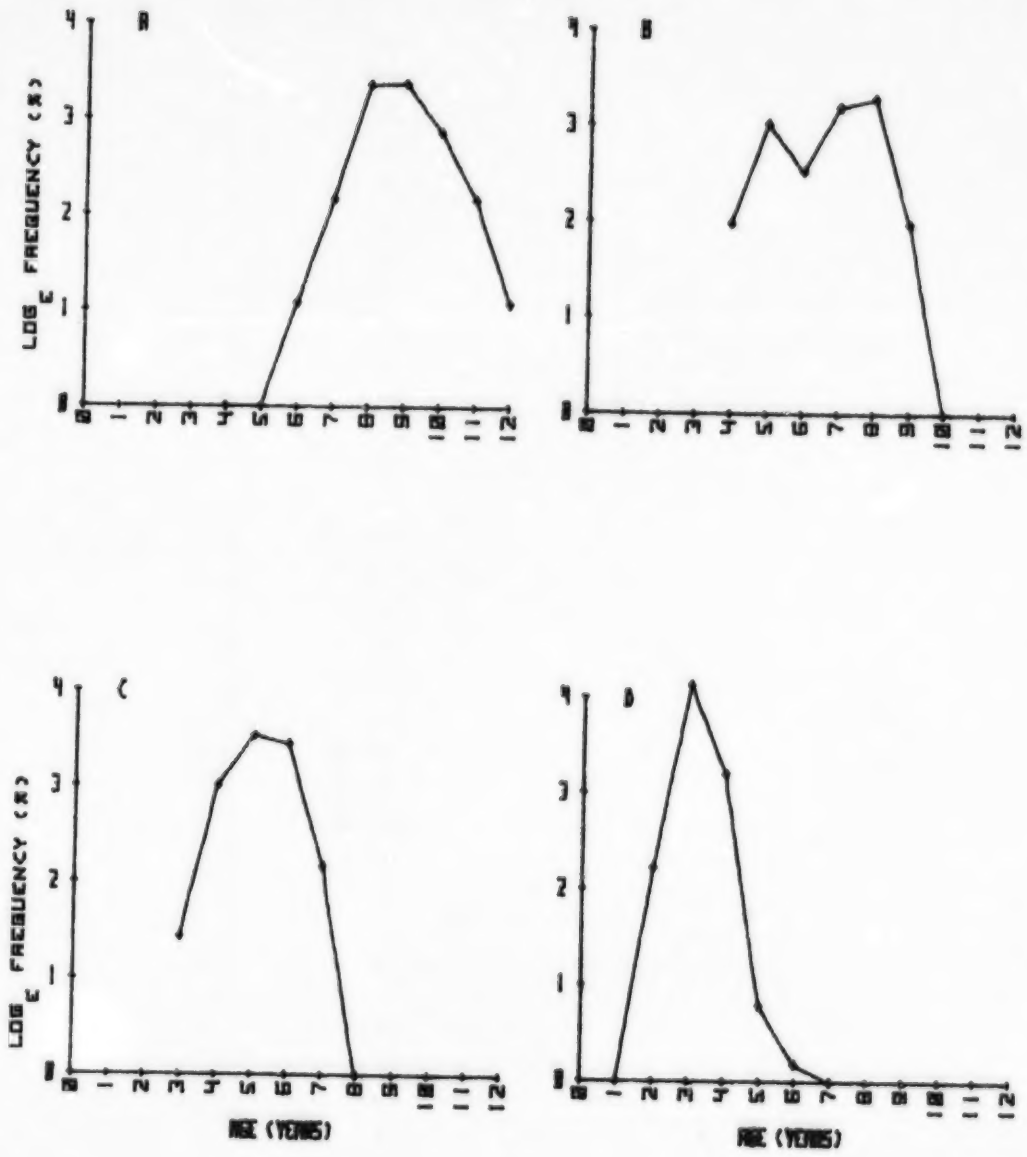

Fig. 64. Catch curves of commercially caught saugers from the channel area (A, C) and south basin (B, D) in the summer (A, B) and fall (C, D).

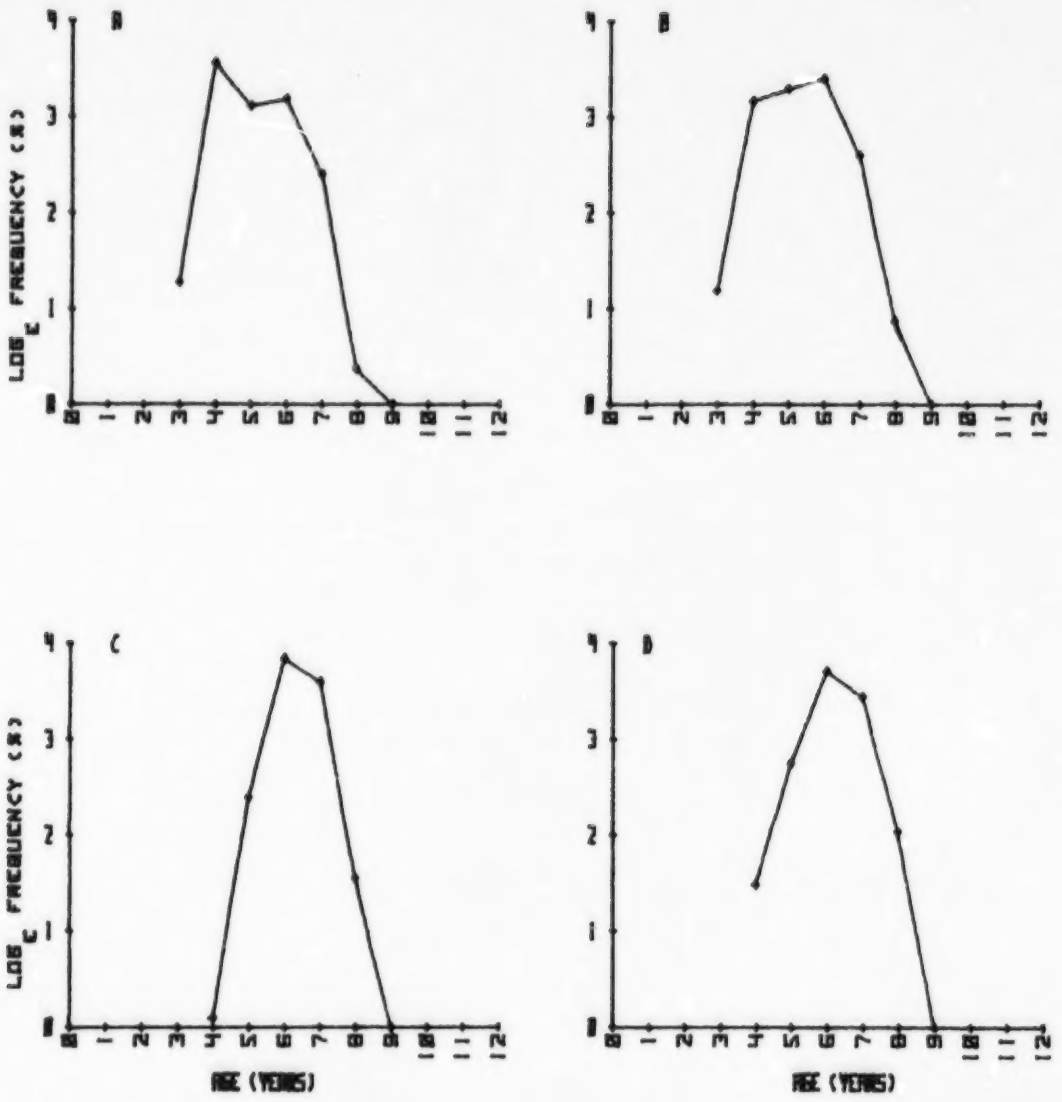

Fig. 65. Experimental catch curves of whitefish from the north basin (A) and channel (B) and commercial catch curves of whitefish from the north basin (C) and channel (D).

APPENDIX A

COMMERCIAL AGE COMPOSITIONS

$\underline{n}$ = number of sampled fish
$\underline{L}$ = mean length (mm)
$\underline{w}$ = mean weight (gm)
a = weighted mean age (years)
Z = instantaneous mortality rate
A = annual mortality rate
S = annual survival rate
2 S.E. = 2 standard errors about the survival estimate.

(see Table 2 for dressed weight samples)

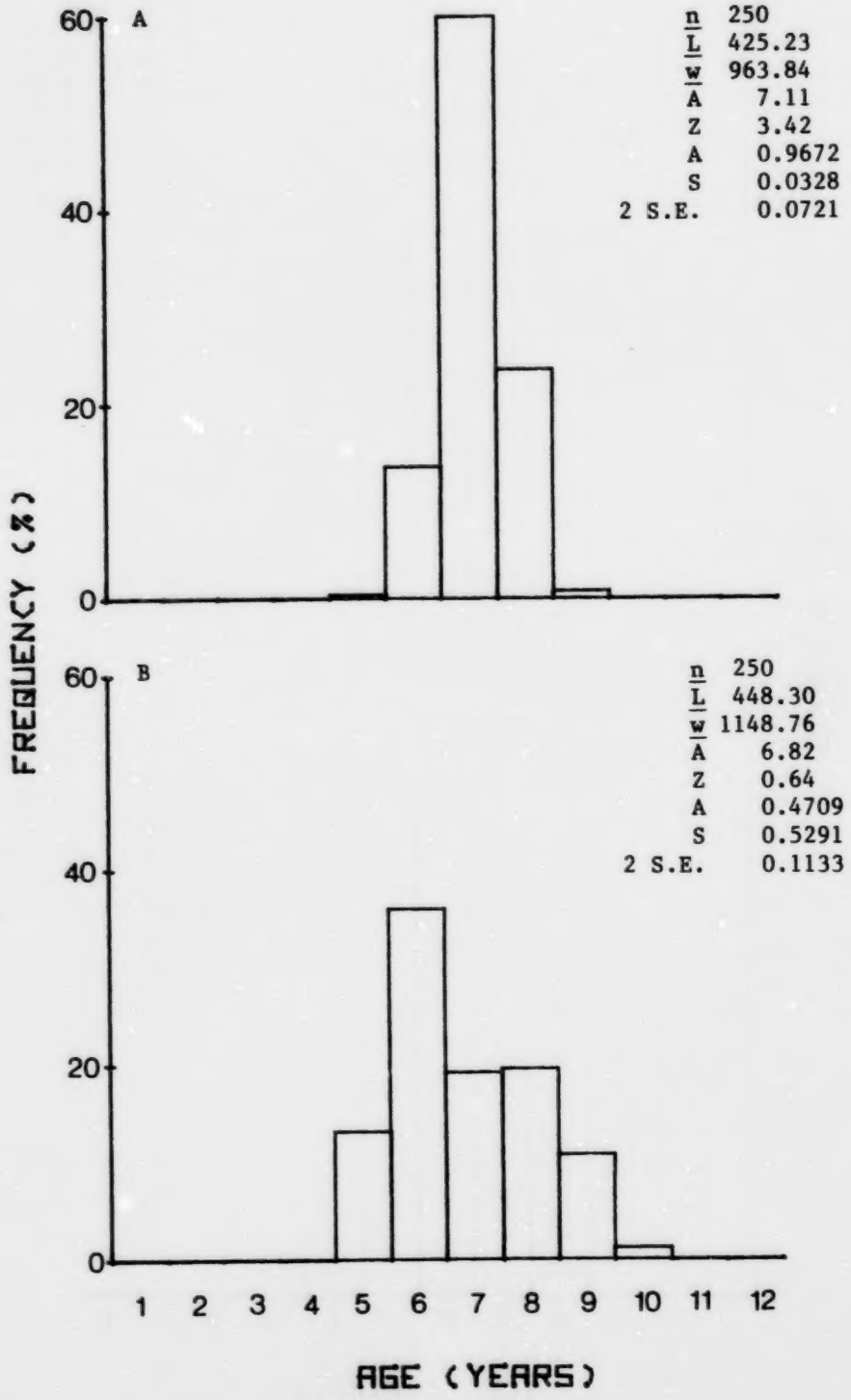

Fig. A1. Age compositions of commercially caught walleyes from Grand Rapids (A) and Big Black R. (B), June 1982.

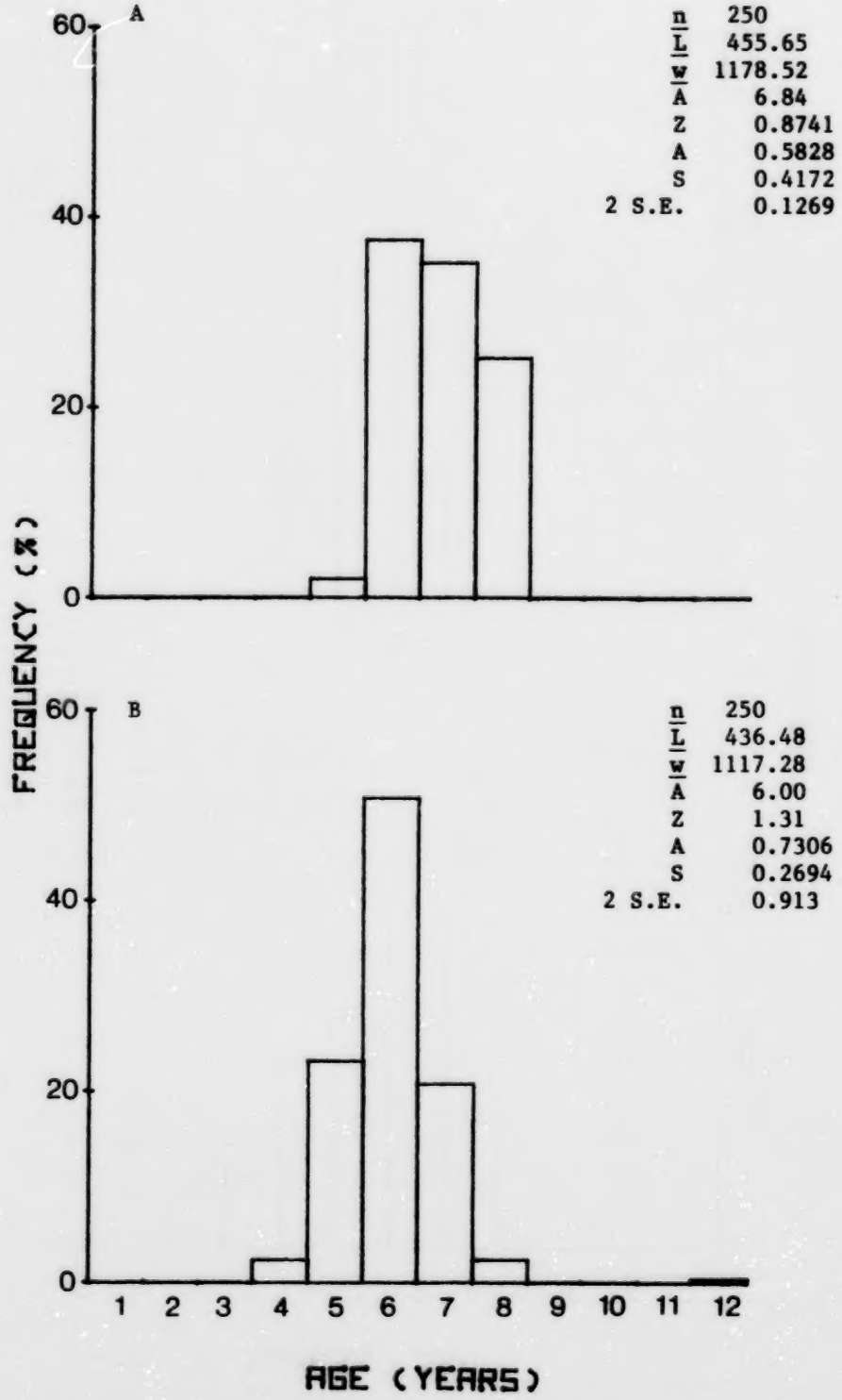

Fig. A2. Age compositions of commercially caught walleye from Gull Bay, June (A) and Grand Rapids, September (B).

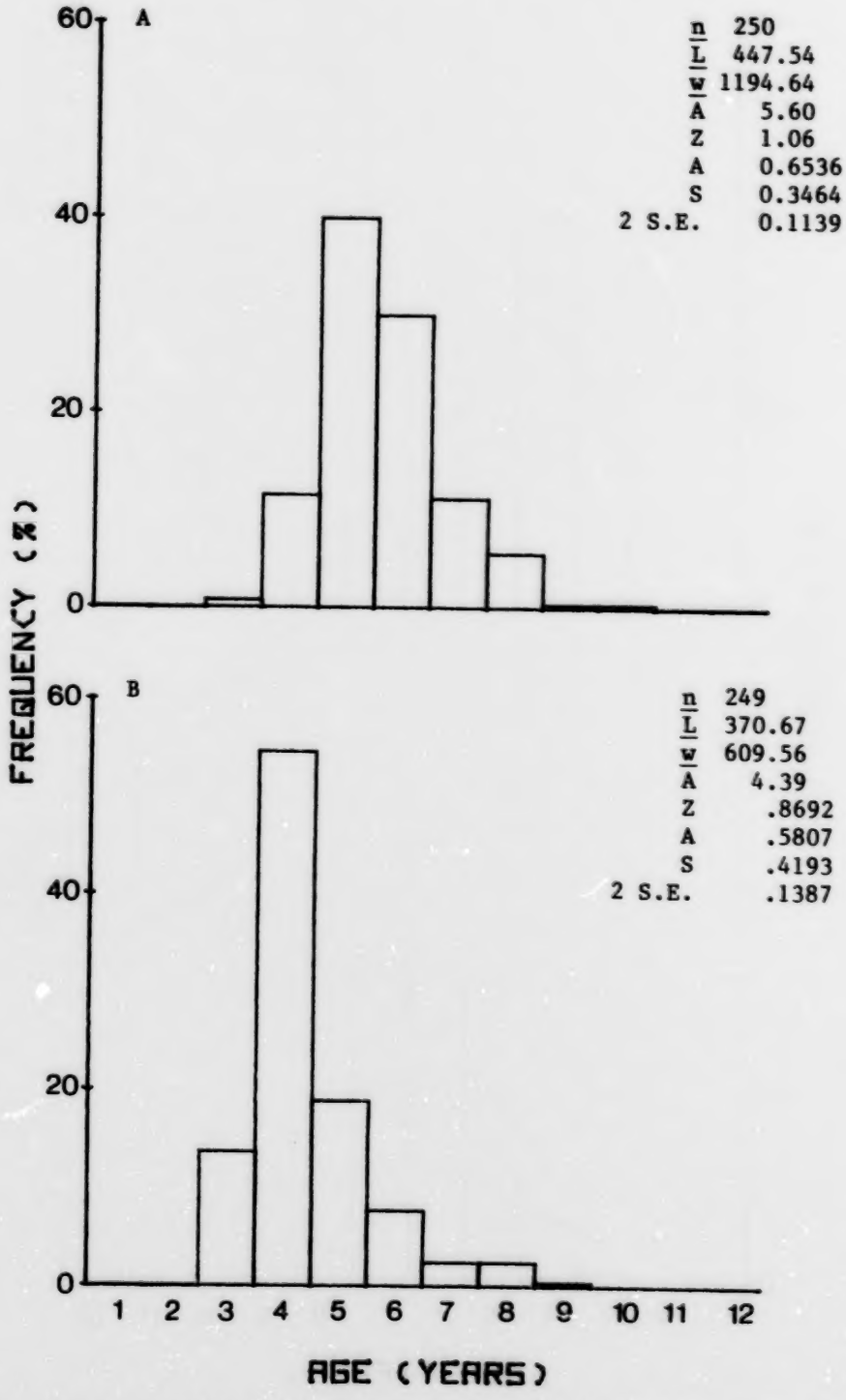

Fig. A3. Age compositions of commercially caught walleyes from Big Black R., September (A) and Matheson Is., June (B).

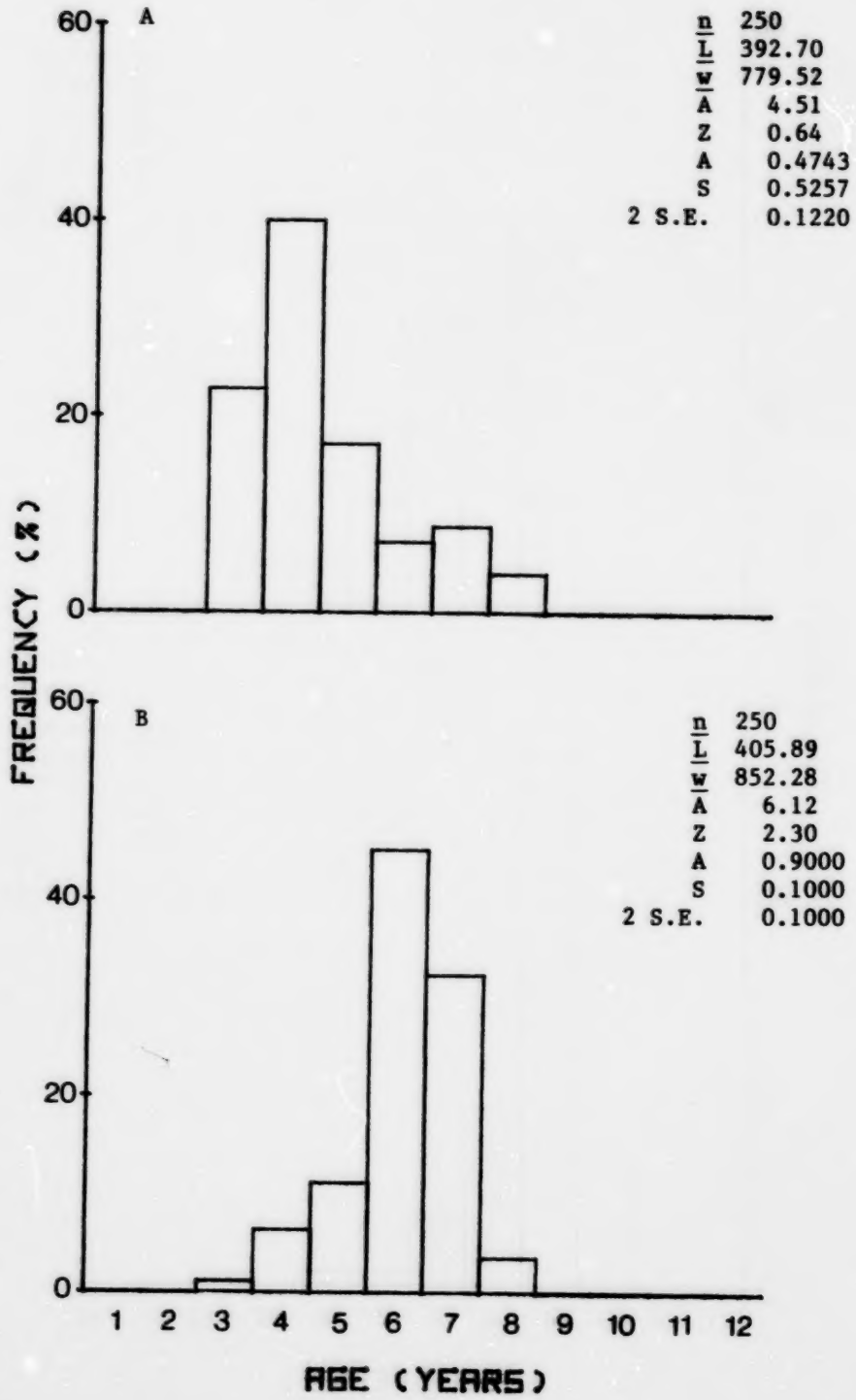

Fig. A4. Age compositions of commercially caught walleyes from Matheson Island, September (A) and Sturgeon Bay, June (B).

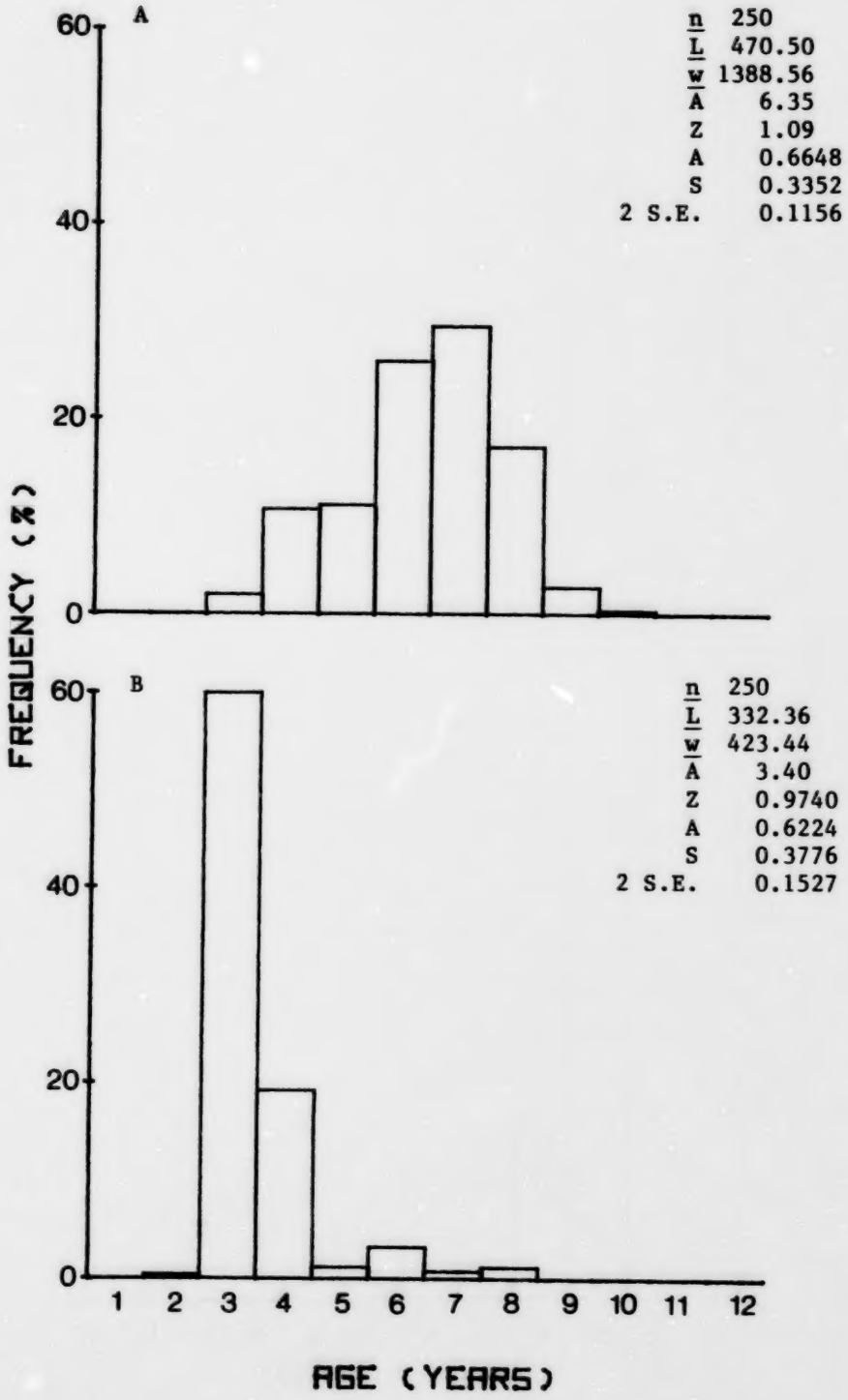

Fig. A5. Age compositions of commercially caught walleyes from Matheson Is., September (A) and Gimli, June (B).

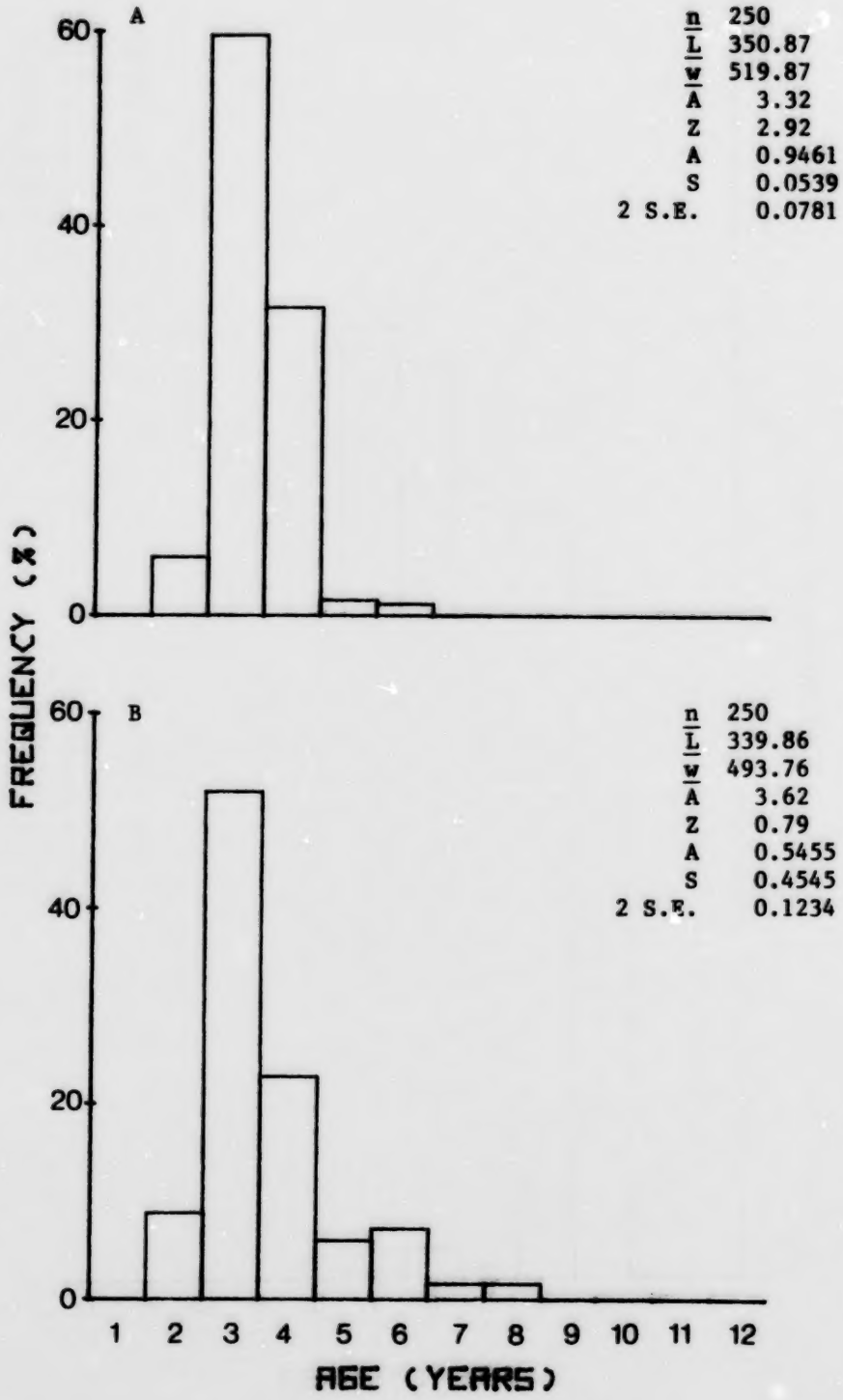

Fig. A6. Age compositions of commercially caught walleyes from Gimli, September (A) and October (B).

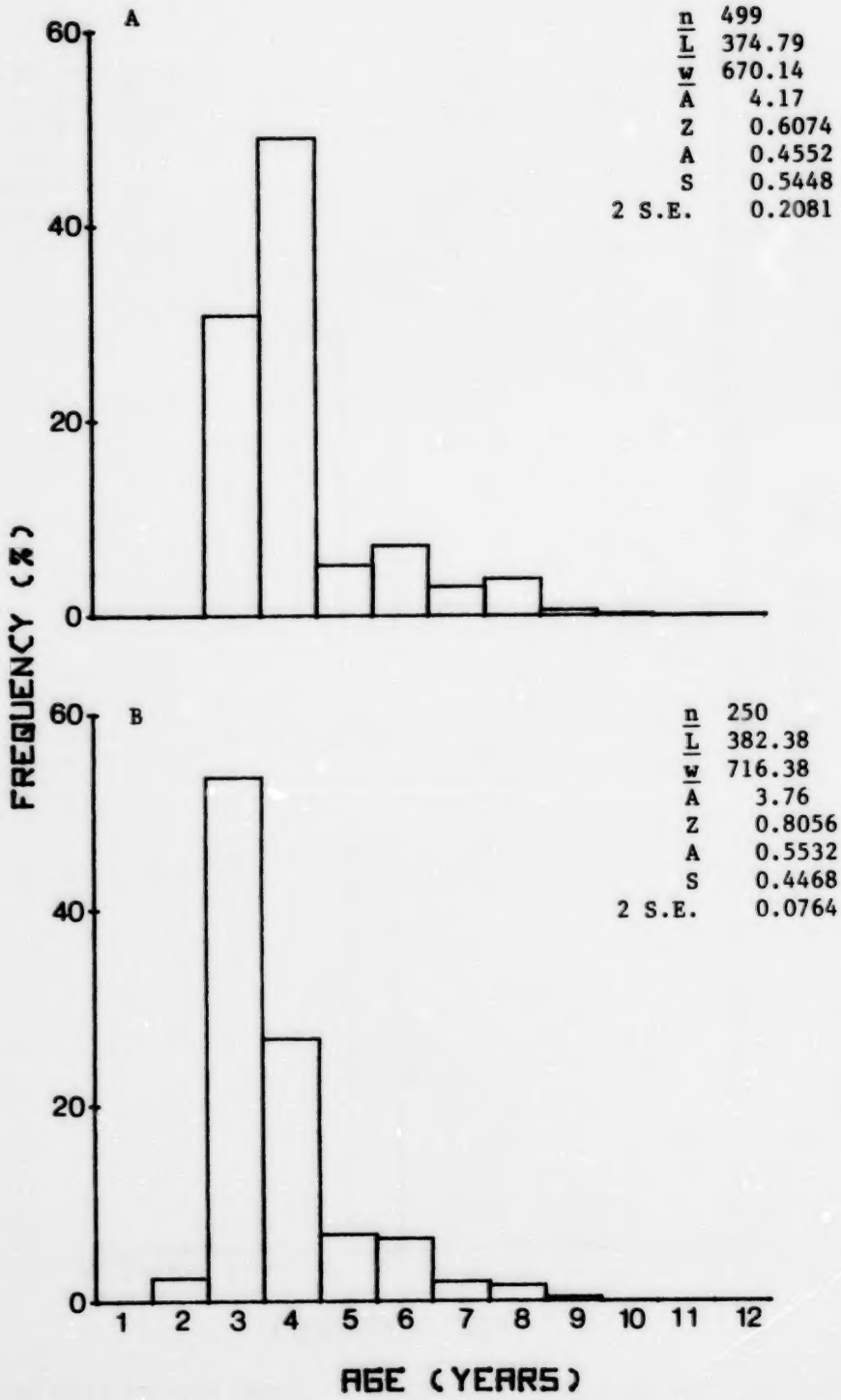

Fig. A7. Age compositions of commercially caught walleyes from Selkirk in June (A) and September (B).

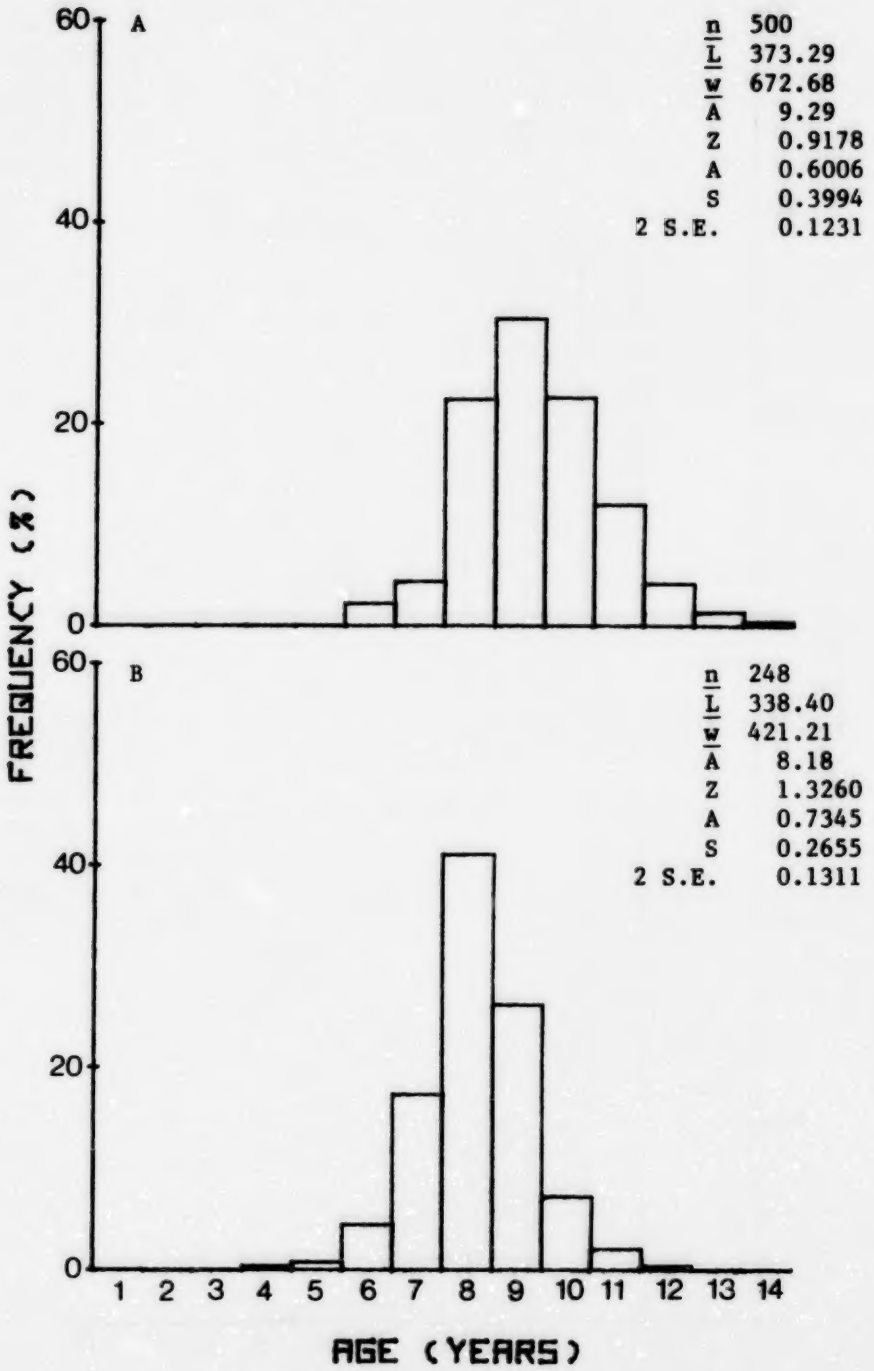

Fig. A8. Age compositions of commercially caught saugers from Berens R., June (A) and Matheson Island, June (B).

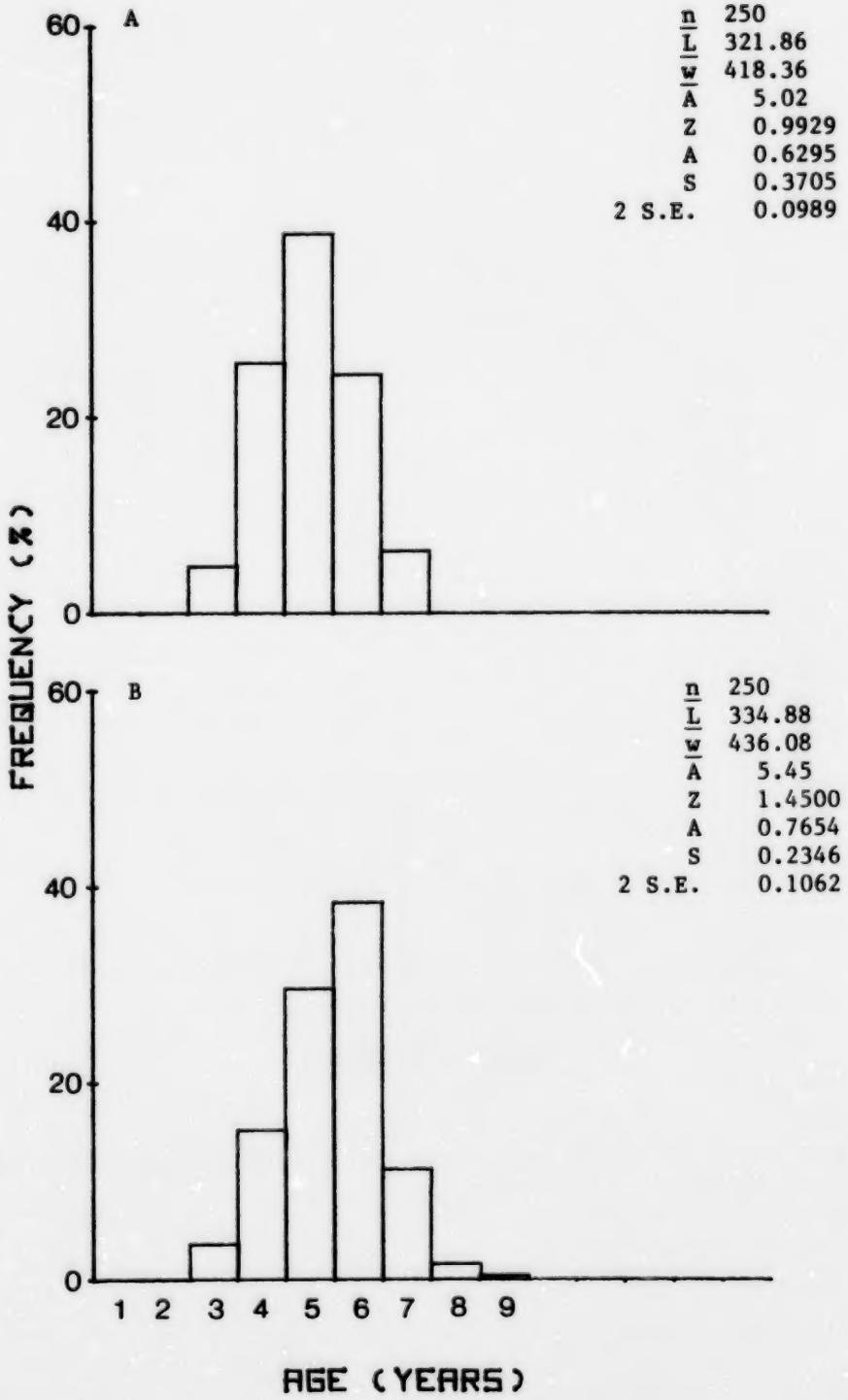

Fig. A9. Age compositions of commercially caught saugers from Berens River, September (A), and Matheson Island, September (B).

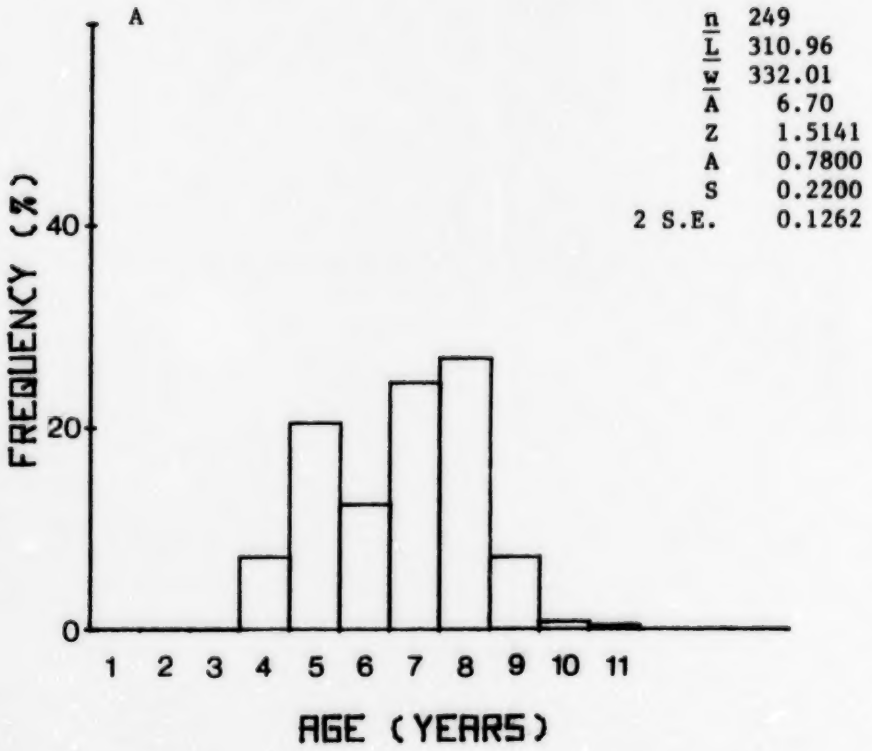

Fig. A10. Age compositions of commercially caught saugers from Selkirk, June.

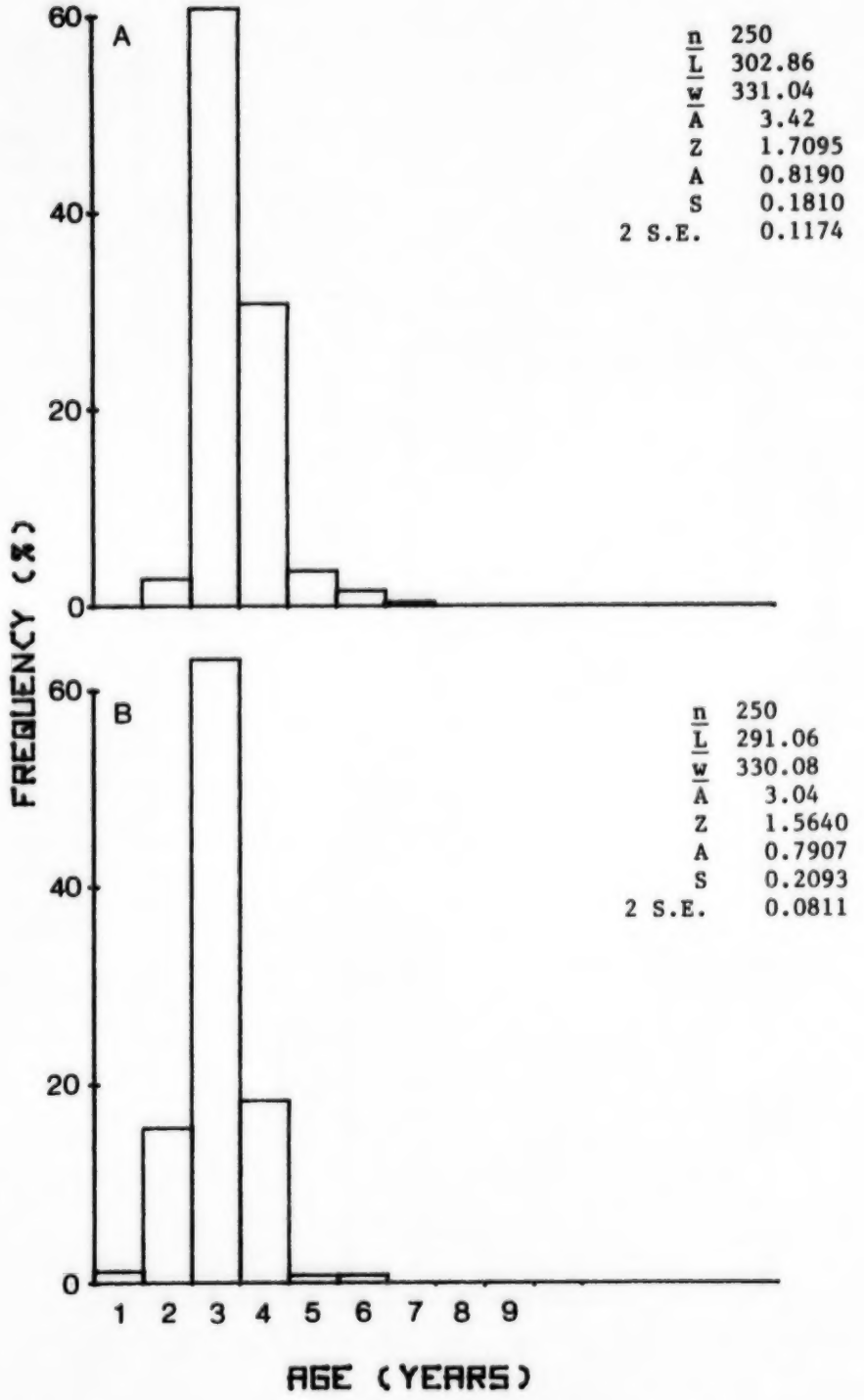

Fig. All. Age compositions of commercially caught saugers from Selkirk, September (A) and Gimli, October (B).

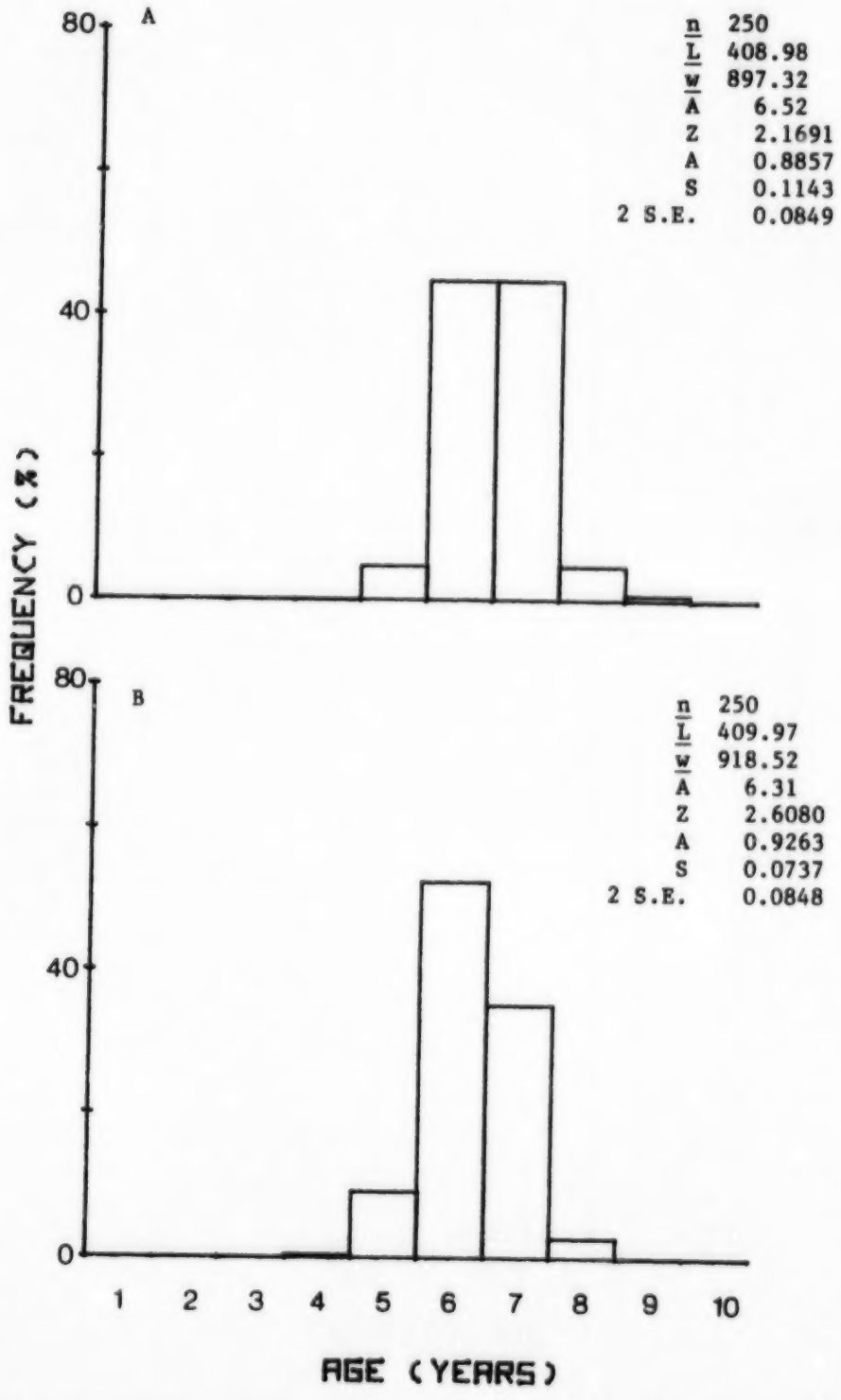

Fig. A12. Age compositions of commercially caught whitefish, June 1982. A - Warren Landing, B - Big Black River.

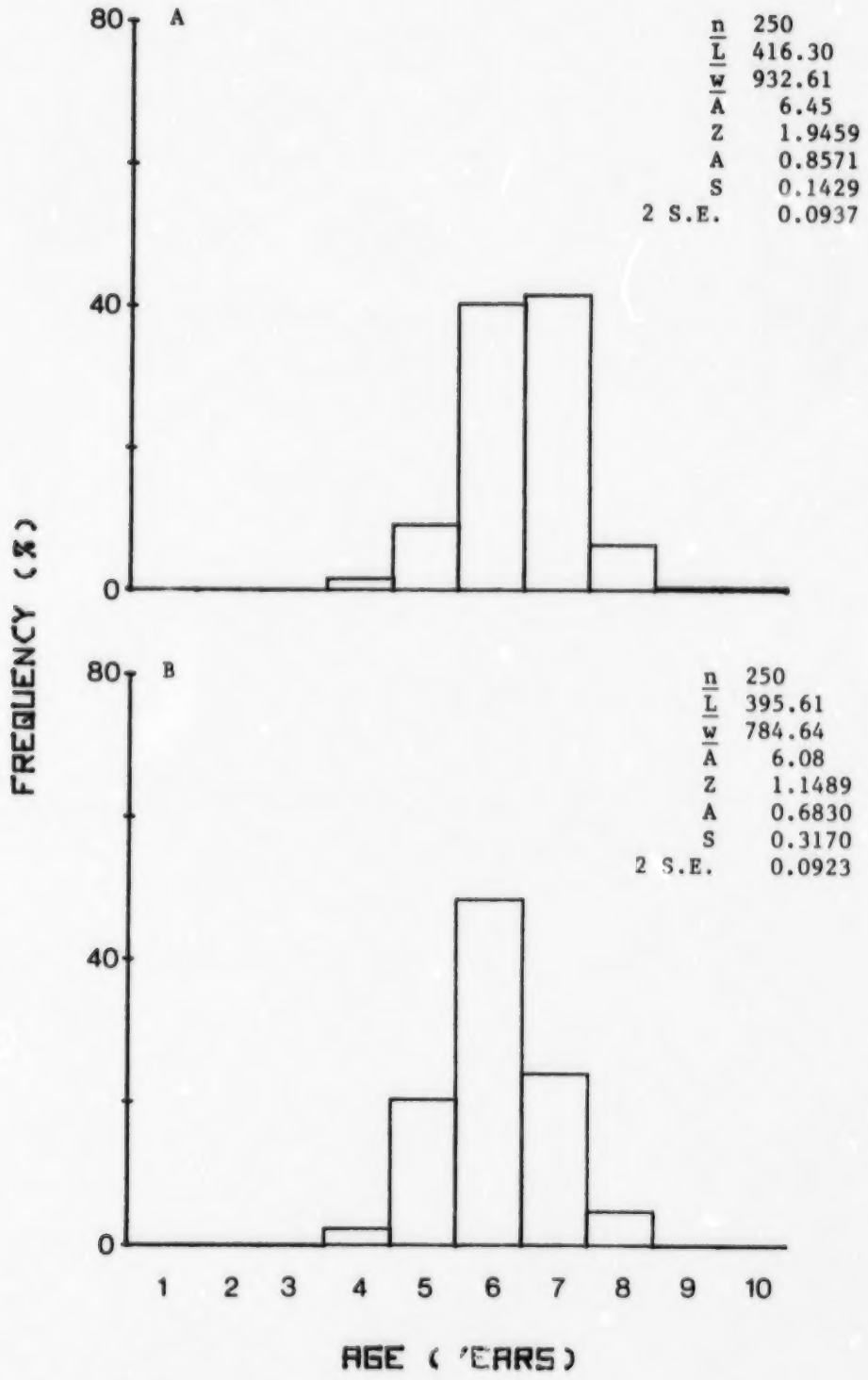

Fig. A13. Age compositions of commercially caught whitefish, June 1982. A - George Island, B - Grand Rapids.

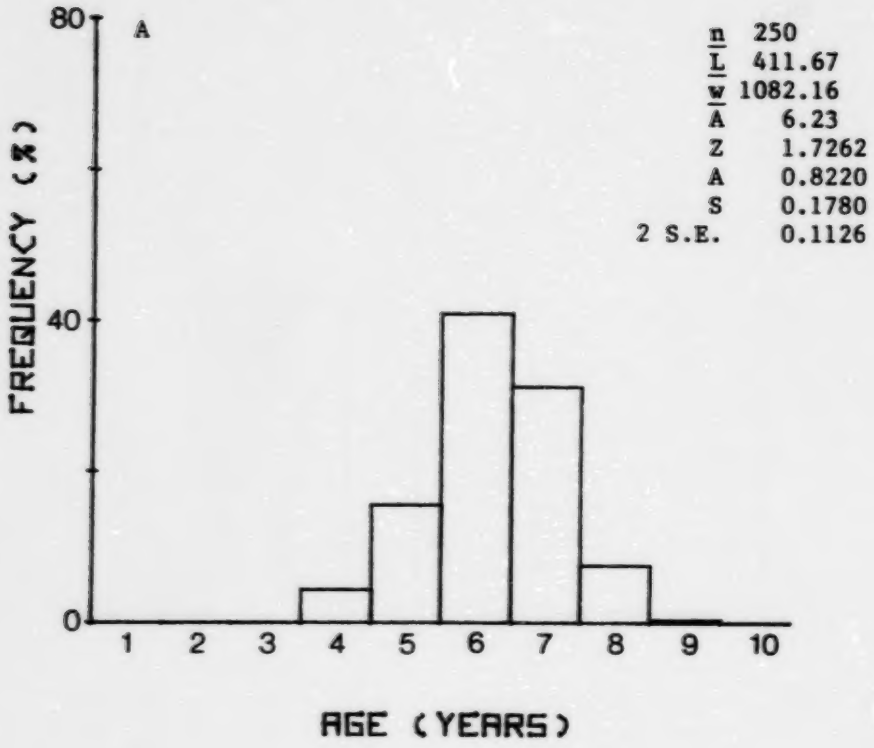

Fig. A14. Age compositions of commercially caught whitefish from Matheson Island, June 1982.